Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XLI. NEW YORK, SATURDAY, FEBRUARY 14, 1903. No. 7.

ELECTRICAL WORLD AND ENGINEER

Published weekly by the

McGRAW PUBLISHING CO.

114 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 7605 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE - - - - - - 1139 Monadnock Block.
PHILADELPHIA OFFICE - - - - - - 929 Chestnut Street.
EUROPEAN OFFICE Hastings House, Norfolk St., Strand, London, England.

NOTICE TO READERS WHO ARE NOT SUBSCRIBERS.

The ELECTRICAL WORLD AND ENGINEER is not returnable from the newsdealer. If you desire to purchase the paper from a dealer it will be to your advantage to notify him that you will want it, in order to insure his having a copy for you. If you wish to receive the paper regularly, please send in your subscription so that we can mail it to you direct.

Single copies are 10 cents each. The 52 copies for the entire year cost $3.00 in advance. Please send remittance with your subscription order.

ELECTRICAL WORLD AND ENGINEER.

NOTICE TO ADVERTISERS.

Change in advertisements intended for a particular issue should reach the office of the ELECTRICAL WORLD AND ENGINEER by 10 A. M. MONDAY of the week of issue. New advertisements can be received up to noon of Tuesday of the week of issue.

The first issue of each month is an export issue, having an extraordinarily large foreign circulation in addition to the regular domestic and foreign circulation of this paper.

TERMS OF SUBSCRIPTION.

United States, Canada or Mexico - - - - - - -	per year, $3.00
Foreign Countries, within the Postal Union - - - - - -	6.00
Great Britain and Ireland - - - - - - - - - - - -	25 shillings
Germany - - - - - - - - - - - - -	25 marks
France - - - - - - - - - - - - -	31 francs
Single copies - - - - - - - - - - - - -	.10

Remittances for foreign subscriptions may be made through our European office.
In requesting your address changed give OLD as well as new address.

Copyright, 1902, by McGRAW PUBLISHING CO.

Entered as second-class mail matter at the New York Post Office.

NEW YORK, SATURDAY, FEBRUARY 14, 1903.

CONTENTS.

Editorial 265
Annual "Library" Dinner of American Institute of Electrical Engineers.. 268
Electric Water Power at Manchester, N. H., Mills 269
Ampere-hour Capacity of the Lead Storage Battery. By A. L. Marsh.... 271
An Arrangement for Power Stations for Operating Steam Railways Electrically. By C. J. Spencer 272
The Shawinigan Plant 273
The Construction of Aerial Telephone Lines—III. By Arthur V. Abbott, C. E. 274
Carbide Furnace. By Clinton Paul Townsend 278
Municipal Ownership Convention 278
Developments in the Indiana Telephone Field 279
New Telephone Patents 279
The Engineering of Illumination 280
Independent Telephony in Kansas 280
The Cuyahoga Telephone Company 280
Current News and Notes 281
LETTER TO THE EDITORS:
Stresses in Alternator Frames. By A. Hansson 282
Digest of Current Electrical Literature 283
New Telephone Equipment 287
The Protection of Street Car Motors 287
Integrating Direct-Current Wattmeters 288
10,000-Volt Motor-Generator 289
DEPARTMENTS:
Financial Intelligence 290
Commercial Intelligence 290
General Notes 293
Trade Notes 296a
Record of Electrical Patents 296a
Cable Construction for Telephone Lines ..... Supplement

THE INSTITUTE DINNER.

The annual dinner of the American Institute of Electrical Engineers grows in interest and importance, and the money spent upon it seems to be an excellent investment, regarded as a means of focussing attention on the work and aims of that progressive body. Another point shrewdly considered by the officers is that of giving to each dinner some special feature, so that while Marconi and the ether were the fitting theme in 1902, this year the library associated with the names of Wheeler, Carnegie and other donors is the topic. The banquet at Sherry's on Monday night, attended by nearly three hundred inclusive of leaders in the industry and science, must be regarded as in every respect a great success. Had no other element of interest characterized it, the remarkable speech of Mr. Carnegie would have made it memorable. It was indeed a delightful "human document," and every one was thrilled as he recounted his own early struggles in the telegraph field and started on that wonderful career of wealth creation and accumulation that is crowned by his magnificent grants in aid of literature and knowledge.

FATAL NON-GROUNDED LOW-TENSION CIRCUIT.

The importance to electric light and power companies of making use of the recommendations of the national code, which permit the grounding of low-tension circuits, was recently sadly illustrated in a small central station plant in the middle West. In this case it was the chief engineer of the plant who suffered the conseqnences, but this fact serves only the more to show the importance of safeguarding the low-tension circuits by grounding them. Evidently there was a defective transformer, or a cross somewhere in the station between the high-tension and incandescent lighting circuit wires. One of the employees of the station received a severe shock from a drop light. The chief engineer went to disconnect the extension cord, by unscrewing the plug, and was accidentally killed Shocks had been received from this circuit previously. It is astonishing that men of intelligence should take such risks as did this engineer, immediately after direct evidence that the circuit was crossed with some high-tension line. Had the incandescent lighting circuit been grounded, this man would have been protected even against his own carelessness. Customers of an electric lighting company are entitled to this protection.

ELECTRICAL VERSUS COAL CAR TRANSMISSION.

Ever since transmission at high voltage began to be talked of there has been much theoretical discussion on the advisability of locating large generating plants at the coal mines to transmit the power to points of consumption, instead of locating power stations near the various places where power would be used. The proposition is naturally an attractive one to the engineer, who is always on the lookout for methods which, by skillful engineering, may do away with freight and labor charges. As a matter of fact, however, the coal car as against the high-voltage transmission line, seems to have won out in most cases. Of course, there are places in the mountainous districts where the cost of transporting fuel is enormous and where consequently there is little question as to the advisability of transmitting power rather than hauling coal. In a fairly level, open country, on the other hand, it seems to be a difficult matter for the transmission line to compete with the coal car. In Colorado the comparison between these two methods has perhaps been more actively considered than in any other locality in recent

years. In the mountains of Western Colorado there are cases where there is no question as to the economy of transmitting at high voltage rather than hauling fuel to the station at some inaccessible mine. In the Cripple Creek district, conditions are such as almost to balance the two methods. In this latter district can be found power transmitted 26 miles at high voltage from a plant located near the coal mines, and also power supplied from a plant in the district. In this case the country is mountainous. But there is little difference between the cost of power when transmitted and the cost when generated in the district, is shown by the fact that engineers of national reputation have been responsible for the building of both types of plants. Farther east in Colorado, at Denver and Colorado Springs, where the country is comparatively level, nearly every large generating plant that has been built during the past few years, has been executed only after a careful consideration of the ultimate cost of power from a plant located at the coal mines as compared with a plant located in the city. Coal is found near both Colorado Springs and Denver. So far, however, only one plant has been built at any considerable distance from a city for the purpose of getting its coal at the mines. The cost of hauling coal in a level country by modern railroad methods seems to be so low that ordinarily the cost of a transmission line with the fixed charges thereon will wipe out any advantage to be gained from using the coal directly at the mines, and transmitting the power.

But the cost of coal transportation is not the only thing to be considered in this connection. One engineer, who has had occasion to figure on numerous plants of this kind, and who has considered fully the practical as well as the theoretical elements entering into the problem, points out that skilled labor of the kind necessary to operate a large generating plant, can be obtained at the mines only at a much higher rate than if the plant were located in more congenial surroundings. Mining communities are likely to be lonely places for a man who is skilled in power house operation; and if the right kind of men are to be kept there, they must be paid for staying. This is a fact well known to mining men, but not so well known to electrical engineers who figure on problems of this kind. Furthermore, it is frequently figured that if the station is located at the mine, it is for the purpose of utilizing the slack and coal dust that would not be shipped because of its low grade. If this kind of fuel is used, it requires a large boiler capacity per kilowatt, because in practical operation there is always the possibility that a poor streak of fuel will get into the furnace about the time the heaviest load comes on. To provide for such emergencies, the boiler capacity provided must be larger than would otherwise be necessary. As between a large investment and a small one, it is always the case that a decided saving must be shown over and above fixed charges to justify the larger investment. In a level country the high-voltage transmission line, as a competitor of a railroad, does not seem to be yet able to show this saving.

ENTROPY.

An animated discussion appears in recent electrical journals between Mr. James Swinburne and certain of his opponents, upon the definition of entropy. Very few people know what entropy is, and a consultation of dictionaries is apt to inflame the curiosity at the expense of the satisfaction. Mr. Swinburne gives a definition in 52 words without symbols, and an alternative definition in 26 words employing an integral to help him. It must be confessed that neither of the two definitions is very simple, although both are definite enough. Mr. Swinburne says that the ordinary definition of entropy as appearing in the text-books is wrong, and contrary to the meaning of Clausius, the inventor and first employer of the term. It is clear, however, that the entropy defined by Mr. Swinburne is a different thing from the entropy as defined in the text-books, and different names should attach to these two things.

THE AMPERE-HOUR CAPACITY OF THE LEAD STORAGE BATTERY

The electric automobile has done much to reduce the weight of storage batteries. Every extra pound in an automobile battery is one pound more of dead weight to be propelled up hills. The figures given in Mr. A. L. Marsh's article on page 271 show the present limitations of the lead storage cell in regard to weight and output. In the pasted form of cell described, the energy output is stated to have been 16.1 watt-hours per pound of complete cell (or 35.5 watt-hours per kilogramme), in a 24-hour discharge; reducing to 11.4 watt-hours per pound (25.2 watt-hours per kilo) in a 4-hour discharge. The weight of lead peroxide was 17.8 per cent. of the cell weight, so that the above outputs should be increased in the approximate ratio of 6 to 1 in order to obtain the output per unit mass of active material. Very little room appears to exist for the further lightening of such a cell. The weight of the active material formed 55 per cent. of the weight of positive plates. In other words, the positives were less than half grid and more than half peroxide. The negative plates are stated to have presented substantially similar conditions. Consequently, taking all the plates together, the active material formed about half the mass, and the peroxide or positive active material about one quarter of the mass. Only about half of the active material applied appears to have come into useful action, representing, therefore, a useless plate weight of about 75 per cent.

The 24-hour discharge has interest by way of determining the available limits of output; but with automobile cells it is of little practical concern. The 4-hour discharge, or the 3-hour discharge, is the important question. Taking the 4-hour discharge of 11.4 watt-hours per pound, as virtually stated in the article, the cell would be capable of lifting its own weight through a height of about 5¾ miles, in expending this energy without waste. When we remember, however, that a piece of good coal contains enough potential energy to lift its weight 2,000 miles against sea-level gravitation, it is clear that a lump of coal is 350 times richer in energy than a lump of storage battery. Unfortunately, we can only get about 5 per cent. of the energy of coal usefully out of it in an automobile, whereas we can get 80 per cent. usefully out of a storage cell, at the motor axles; so that the disparity is reduced from 350 to about 20. Even at 20 to 1, the energy storage capacity of coal or petroleum is clearly much greater than that of electric storage cells.

THE TRUE EFFICIENCY OF A CENTRAL STATION.

It was said by Edison, many years ago, that the business of a central station company is to sell light. Though this pregnant statement has been reiterated many times since, it is nevertheless opportune to again call attention to the fact that a central station man is too often prone to consider that he is selling current or electrical energy rather than light. The remarks made by Mr. V. R. Lansingh, of Chicago, before the Western Society of Engineers, mentioned elsewhere in this issue, to the effect that central station men are too apt to spend a great amount of money in securing high electrical efficiency, while neglecting entirely illuminating efficiency, found hearty endorsement on the part of several progressive and practical central station men who were present at that meeting. That the central station man may have sometimes been inclined to sell electrical energy rather than light, and to concern himself little with what became of the current after it passed the consumer's meter, is, of course, due to the modern system of selling electrical

energy by meter rather than selling candle-power hours. If it were possible to sell candle-power hours, that would, of course, be the ideal basis of charge for electric light. This not being feasible, we are obliged to go back another step in the transformation of energy, and measure the electrical energy used in making the light. Central station men have given a great deal of attention to making possible by good voltage regulation the use of high-efficiency lamps, and much of the best engineering thought has been given to this matter. It is neither logical nor business-like that he should say arbitrarily to his customers what shall be done with the energy after it reaches the lamp filament or the arc, but nevertheless a central station man can, if he will, conduct a campaign of education in the proper use of electric light among his customers so as to secure the best possible illumination with a given amount of electrical energy.

The narrow-minded theory that the more current a customer uses the better, without regard to how he uses it, has long ago been discarded by progressive and business-like central station men, as well as by gas men. It is entirely to the interest of central station companies that lamps and methods of illumination used by consumers be of the highest possible efficiency, so as to reduce the cost of light to the consumer as far as possible. While this may mean that one consumer will get along with smaller bills than he would otherwise have to pay, it also means that the company will add three or four new customers where otherwise it would add none. If a man finds that his neighbor is getting electric light at a very reasonable rate, and sees that the illumination that he is securing is superior, he is tempted to become a customer; while, on the other hand, if he finds that his neighbor is paying a high rate for poor service, he stays out of the game. While it is true that the consumer, especially in a large city, likes to use his electric light in his own way, it is also true that there is a great chance to educate the consumer as to the arrangement of lights and the use of reflecting and diffusing globes, which will give the best results. To this end central station men should make a careful and conscientious study of illumination. Many of them have been so busy chasing leaks around the central station distribution system that they have had no time to become thoroughly posted on this branch, but the day is coming when this will be necessary.

DISTRIBUTION OF POWER FOR RAILWAYS.

The question between sub-stations and distributed stations in electric railway working, once more raised by Mr. Spencer's paper in the current issue, is one which we have often discussed. The advantages of one system or the other have been often exploited, and it seems to us that Mr. Spencer might have made out a far stronger case than he has for distributed stations if he had confined their use to street railways instead of recommending them for heavier work. In point of fact, the single commanding gain in using power distributlon at high voltage for extended street railway systems is the very one that Mr. Spencer disclaims, while the gains he cites are the very ones which it is difficult to substantiate. The loss in transmission, including a proper allowance for maintenance and the loss in the rotaries, is very far from being "slight." It is, in fact, so considerable as in many instances to quite offset the advantage of size and position in the central station. We call to mind divers instances in which power transmission is a costly luxury, which has been indulged in as a mere matter of fashion. So long as the energy transmitted has to be put through rotary converters to fit it for use, the gain in generating the power at a single point is problematical in perhaps the majority of cases. Of course, when water power can be utilized a different question arises, but we are speaking of the more common cases where steam is the motive power. In some instances real estate is a material part of the first cost and there may be a gain in investment by proper location of the main station.

As a rule, however, the gain in power transmission comes from improved efficiency of the generating plant and particularly in the matter of load factor. It is true that on many systems the peaks at the sub-stations fall at about the same time, but this does not imply coincidence of the brief and severe demands for current that characterize railway work, so that the average load on the central station is often much nearer its maximum load than in the case of any sub-station or any separate station that would replace it. The gain in load factor is the most important one in the majority of railway systems using power transmission at high voltage. This applies with double force to the case of electrically equipping the main line of a railway, because a brief examination of the schedule almost invariably shows that the load of any given sub-station would be subject to great variations while that on the central station would be fairly uniform. This is an inevitable outcome of the comparatively small number of trains per unit length of track. The large railway, therefore, has particularly good reason to favor power transmission. Could the conversion to direct current be accomplished by apparatus requiring no more attention than static transformers, the scope of power transmission would be immensely extended, but up to the present nothing more simple and efficient than the rotary converter has come into use. Our correspondent, by the way, seems to think that rubber-covered cables are customarily used for high-voltage transmission, while actually nearly all such work is done over bare wires of very moderate cost.

The main difficulty to be overcome in case of large railway work is not the transmission of the power as such, but the low voltage which is up to the present generally employed on the working conductors. This is a very serious matter in large work. The ordinary freight or express train as now made up for railway service would require from 1,000 to 1,500 amperes at 600 volts, and no method has yet been devised for collecting so large an amount in a satisfactory manner. The one direction in which to look for great and revolutionary improvements such as will make heavy electric traction commercial is the utilization of high voltage on the working conductors. Until this is accomplished the great cost of working conductors and the difficulty of gathering currents of the magnitude now required will stand as an effective bar against serious trunk line work. Of course, were only passenger traffic under consideration a large number of single large motor cars could be used which would somewhat relieve the current-collecting difficulty, but no scheme of electric traction confined to passenger service is likely to appeal strongly to the conservative railway manager. Hence we are inclined to think that our correspondent's scheme of salvation is faulty. The usefulness of storage batteries to steady the load on small stations will hardly be questioned, however, though a battery for this service is better in the station than away from it. This matter of applying electric traction on trunk lines is a most important one, but it involves some practicable method of using several or many thousand volts on the working conductor, whether it is to be utilized in the motors as alternating or direct current, at high or low voltage, and in this connection we look forward with keen interest to the approaching trials of the Arnold, Lamme and Ward Leonard systems. Until such a method is demonstrated, heavy electric traction must be confined to special cases in which electrical operation is of fundamental importance irrespective of minor questions of economy in generating the power. There is an ample field for it even with these limitations.

Annual "Library" Dinner of the American Institute of Electrical Engineers.

The annual dinner of the American Institute of Electrical Engineers, devoted this year to the celebration of the success of the library, was held on Monday, February 9, at Sherry's, and was attended by nearly 300 ladies and gentlemen. It was in every respect a notable affair, many of the prominent members being present from all branches of the profession, including Past President Dr. F. B. Crocker, Louis A. Ferguson, president, and H. L. Doherty, past president National Electric Light Association; F. W. Jones, J. C. Barclay, L. B. Stillwell, C. W. Price, Dr. F. B. Herzog, Frank J. Sprague, J. W. Lieb, Jr., T. E. Murray, G. A. Hamilton, A. B. See, A. A. Knudson, Dr. L. Waldo, Dr. O'Reilly, Prof. W. L. Robb, F. H. Taylor, C. A. Terry, Joseph Wetzler, F. V. Henshaw, P. A. Bates, A. L. Doremus, W. C. Andrews, Kern Dodge, C. Day, P. B. Delany, Oberlin Smith, C. G. Young, Capt. E. L. Zalinski, W. C. Gotshall, W. S. Howell, G. H. Guy, E. G. Bernard, Ira W. Henry, H. G. Reist, H. A. Lardner, J. J. Mahony, C. J. Field, M. M. Davis, R. A. Fliess, H. Wray Weller, F. A. Scheffler, F. A. Pattison, R. W. Pope, C. Blizard, D. Burnett, C. E. Knox, J. Appleton, J. Bijur, C. A. Bragg, Alex Churchward, H. B. Coho, Eugene Lewis, W. M. Kenyon, Dr. Max von Recklinghausen, Lambert Schmidt, F. Shepard, A. K. Warren, T. C. Wood, Theo. Dwight, Prof. W. E. Goldsborough, J. H. Hallberg, F. Darlington, R. D. Lillibridge.

Mr. Thomas A. Edison was also present accompanied by his wife, both taking a keen interest in all that was going forward, and Mrs. Andrew Carnegie was also a guest with her famous husband.

The committee in charge of the affair, all of them who worked hard, were Messrs. T. C. Martin, chairman and toastmaster; W. J. Hammer, W. S. Barstow, E. H. Mullin, Prof. W. Hand Browne, B. Gherardi, Jr., Arthur Williams, Calvert Townly, F. C. Bates, Dr. S. Sheldon, S. L. Nicholson, Calvin W. Rice, S. W. Ashe, Prof. G. F. Sever, Max Loewenthal and L. B. Marks. The room was beautifully illuminated and decorated through the generosity of the Elblight Company of America, through Mr. Russell Spaulding, and the New York Edison Company, who supplied special circuit and current to the Elblight cables and designs. There were festoons of colored lamps all around the ballroom walls, draped in smilax, and above the speakers' table were a large badge of the Institute in colored lamps and two signs of lamps reading "73," the telegrapher's greeting. At the speakers' table were seated President C. F. Scott, Mr. Andrew Carnegie, Dr. S. S. Wheeler, Mr. T. C. Martin, Dr. S. Sheldon, John Fritz, Theodore L. De Vinne, C. O. Mailloux, R. R. Bowker, Dr. J. S. Billings, Mr. Edward D. Adams, Dr. J. C. Bayles, Prof. Elihu Thomson, and Hon. R. G. Monroe, commissioner of gas and electricity for New York.

A special menu had been prepared for the occasion representing in fac-simile, in large quarto, the volume owned by the Institute of the works of Albertus Magnus, printed in 1494. This was in three colors showing the vellum back, labels, wooden board sides and brass clasps. Inside were reproduced in fac-simile two pages of the text, and there were four pages devoted to menu, programme, list of committees, donors to the library, etc. There was also a printed memorandum on the library and its constituent parts.

The intellectual part of the evening's programme began with a salutatory from President Scott, who noted that during his year of office the Institute had done honor to Mr. Marconi and Lord Kelvin. He advanced the idea that electricity was the foe of narrowness and that it increased human and individual efficiency. As for the Institute, its standard for full membership was exclusive; for associate membership inclusive; and on these lines the growth had been rapid of late, crossing the 2,000 mark; while chapters were springing up all over the country. He preached the doctrine of co-operation and showed that in endeavoring to secure better quarters for its library and its meetings, the Institute was anxious to proceed along the lines laid down by President Pritchett, of the Massachusetts Institute of Technology, when he said: "Isolation indicates a low state of civilization," and who urged co-operation. Mr. Scott referred gracefully in this connection to the work done by the Institute in assisting to found the John Fritz gold medal for engineering achievement.

It may well be doubted whether Mr. Carnegie ever made a better speech than that which he delivered on "Libraries," or whether he ever had a more royal reception than was given him by the members by way of acknowledgment of his gift of $7,000 toward the Institute Library work. He has founded nearly 800 libraries, but as one who earned some of his first wages as a telegraph messenger and operator, he claimed the right to be especially privileged to associate himself with the profession that had grown up since he had worked at the key. To quote from his own quaint reminiscences that sent a thrill through the sympathetic audience and moistened many an eye: "Before the electrical engineer was, we—Mr. Edison, Mr. Barclay and myself, we messenger boys—were. There was no engineering electricity in those days, but I have delightful reminiscences. I chew the cud over them many times. The greatest change that ever came to me was when I was passed from the dirty cellar of an engine room—I was firing the engine and running it, too, and many times afraid it would explode—and translated to a telegraph office, where they had clean paper, clean pens and clean windows. That, ladies and gentlemen, was my first glimpse of a paradise on earth in making a livelihood. When I first became able to touch that instrument, and, pounding the key, call up New Orleans—I had been practising surreptitiously before the operator came in the morning, receiving the princely salary of $25 a month, I said to myself this is what Swedenborg said about Heaven: space was annihilated. So when I see Mr. Edison and others, then, I think, why, boys, you're a new generation. But knowing what you do, no fond father was ever prouder of his boys than we are, Edison, Barclay and I."

In introducing Dr. Wheeler, founder of the Institute Library, and donor of the Latimer Clark collection, Mr. Martin recalled the fact that 18 years before Dr. Wheeler and he had drawn up a scheme for an Institute home and library, predicated upon the acquisition of the Clark books. Dr. Wheeler, who was received with three hearty cheers, gave a modest story of his acquisition and referred gracefully to the gifts of his fellow members which had since gone to build up on that foundation.

At this juncture an amusing incident occurred. The toastmaster read a telegram from the Cincinnati chapter, which met that night 55 strong, and sent its congratulations to the parent society, adding: "Tell Carnegie we also could use a library." Amid great laughter the toastmaster handed this to Mr. Carnegie, who brought down the house by deftly waving it aside and saying: "No, no; give that to Wheeler," thrusting it at the same time into Dr. Wheeler's hands. It was some time before the merriment subsided.

Mr. R. R. Bowker, editor of the *Publishers' Weekly*, and formerly vice-president of the New York Edison Company, then followed with a brilliant speech on the "Unity of Science," which he closed with an original poem inscribed to "The Man of Science," on the scope of the work of the modern electrical engineer. He was succeeded by Dr. John S. Billings, director of the New York Public Library, who treated with great skill on the subject of "The Technical Library," and showed how usefully it could supplement the work of the larger, more popular institutions. He referred with hearty approval to the lines of work laid down by Mr. W. D. Weaver, the chairman of the Institute Library Committee.

Mr. Theodore L. De Vinne, the celebrated American printer and bibliophile, then spoke earnestly on the "Debt of Mechanics to Science," and on the part played by electrical engineers in creating wealth and opportunity and in harmonizing the relations not only of mechanics and science, but of capital and labor. The final speech, full of brilliant wit and good-natured fun, largely at the expense of the technical press, was made by Dr. J. C. Bayles, M. E., technical editor of the *New York Times*, who convulsed his audience even at that late hour with clever stories and keen thrusts of wit. The toastmaster then declared the function ended, and recognized while doing so the handsome voluntary contributions of such men as Mr. Edward D. Adams, who had recently given the Institute a full set of the transactions of the Royal Society of England.

The memorandum prepared by the chairman of the Library Committee gave interesting data about the various gifts and the personal interest taken in the members was evidenced in the fact that no fewer than 40 of them have contributed already to the collection. The chief contributors, members and others, named on the menu, besides those noted above, were Messrs. C. O. Mailloux, Cary T. Hutchinson, Joseph Wetzler, C. L. Clarke, Bion J. Arnold, N. S. Keith, Edward Caldwell, American Bell Telephone Company and the New York Electrical Society.

Electric Water Power at Manchester, N. H., Mills.

ELECTRICAL supply systems operating with water power are serving large as well as small consumers of energy. An example of a great industrial plant operated with power from distant waterfalls through the medium of an electrical supply system exists at the Manchester Mills, Manchester, N. H. These mills draw energy for the operation of 976 hp in induction motors and the equivalent of 7,050 16-cp incandescent lamps from the sub-station of the Manchester Traction, Light and Power Company in that city.

This company, as recently pointed out in these columns, draws its energy mostly from four water power stations located at points respectively 3, 6, 10 and 13.5 miles from the sub-station in Manchester. The Manchester Mills are located about 1.25 mile from the sub-station of the light and power company, and two circuits are run from the sub-station directly to these mills and are used exclusively for the service there. Each of these circuits delivers energy at 3-phase, 60-cycles, and at about 2,300 volts. One of these circuits, devoted exclusively to lighting, is composed of three aluminum cables, each having a cross-section of 500,000 cm. The other circuit consists of three aluminum cables, each with a cross-section of 750,000 cm, made up of 37 No. 7 wires, and this circuit is devoted to the operation of induction motors. Either of these circuits can be opened at a point about one-fourth mile distant from the Manchester Mills by a 5-amp switch located on the switchboard there. No fuses are used between the 2,300-volt lines and the motors at these mills, oil circuit-breakers being depended on entirely to open the connections in case of overloads.

The lighting load at Manchester Mills that is operated from the lighting circuit previously mentioned includes incandescent lamps numbering 4,092 of 16 cp each, and 1,012 of 24 cp each; also 24 enclosed arc lamps, taking 6.6 amp at 73 volts. These lamps are supplied by the 2,300-volt, 3-phase line through seven transformers of 30 kw, 5 transformers of 25 kw, and 2 transformers of 20 kw each, giving an aggregate capacity in lighting transformers of 375 kw.

Drawing energy from the electrical supply system at these mills are two motors of 200 hp each, 6 motors of 75 hp each, 1 motor of 50 hp, 1 motor of 30 hp, 3 motors of 10 hp each, 1 motor of 15 hp, and 1 motor of 1 hp. The combined rating of these motors is 976 hp. The 2 200-hp motors and 4 of the 75-hp motors are connected directly to the 2,300-volt motor circuit, no transformers being used to lower the voltage for these 6 machines. The remaining 276 hp of motor capacity which draws energy directly from the supply system are operated through transformers at 550 volts.

All of the motors thus far named are of the 3-phase, 60-cycle induction type. Each of the 200-hp motors operates at 500 r.p.m., and is direct-connected to 2 arc dynamos, each of these dynamos being rated at 125, 6.6 amp, 73-volt arc lamps. Two 75-hp motors at 600 r.p.m., one 50-hp motor at 720 r.p.m., 1 15-hp motor at 1,200 r.p.m., and 3 10-hp motors at 1,200 r.p.m. are belted to shafting in various parts of Manchester Mills. The four arc dynamos operate enclosed arc lamps in the several mills, and about 400 of these lamps are now in use.

Manchester Mills are famous for their fine cotton prints, and the printing of these cottons is done by electrically-driven machines. Sixteen of these printing machines are in use and each is driven through a belt connection by a 25-hp, 220-volt, direct-current motor. The requirements of this printing work include close regulation of the speed of each machine from zero to the maximum rate. In order to secure this regulation of speed and at the same time maintain a high efficiency, current is supplied to each of the 25-hp motors

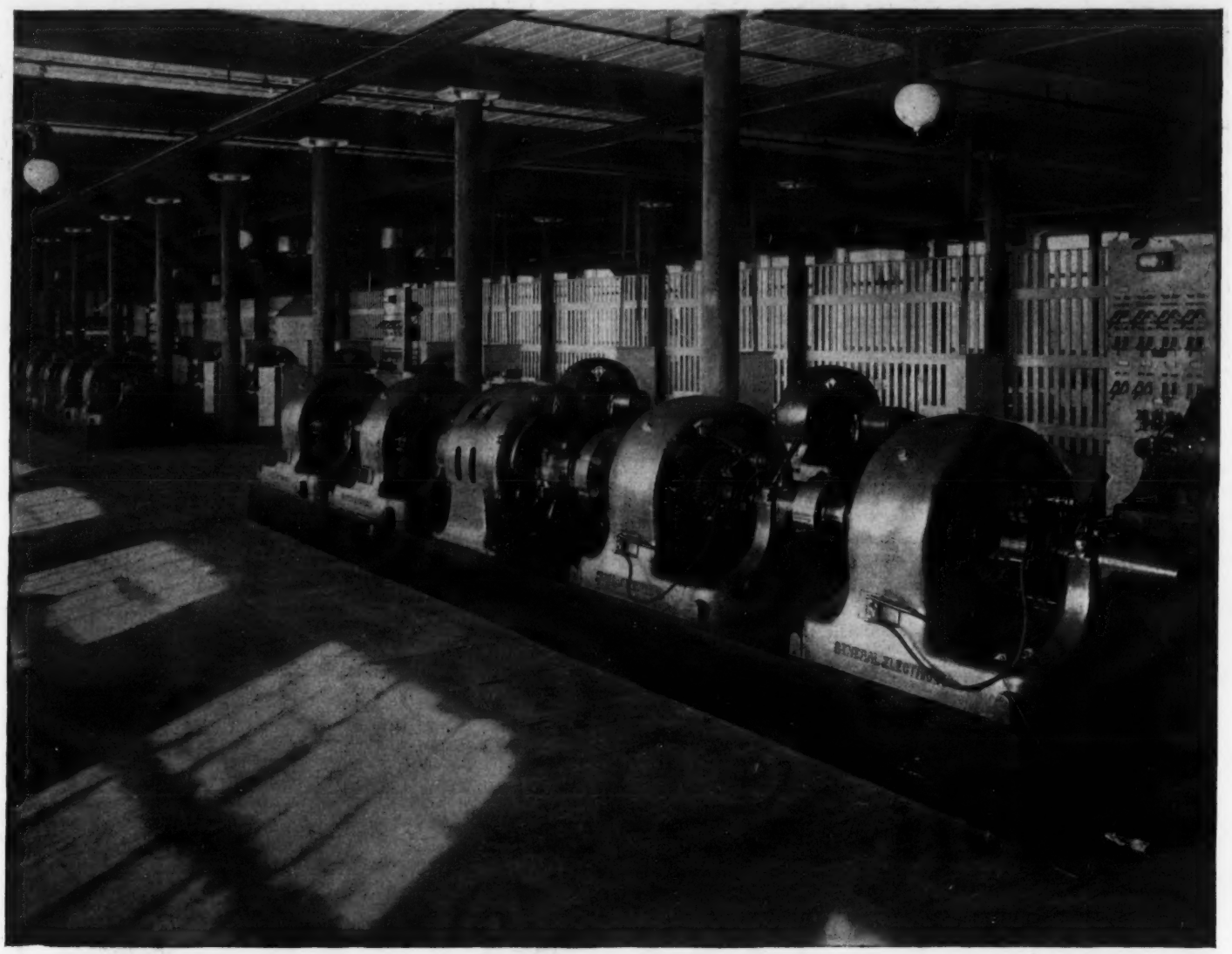


FIG. 1.—INDUCTION MOTORS DRIVING DYNAMOS, MANCHESTER MILLS.

at variable voltage. For each 25-hp motor driving a printing machine there is provided a 20-kw, 250-volt, direct-current dynamo, which supplies current to the motor armature. The shunt magnet winding on each of the 16 motors of 25-hp, and on each of the 16 dynamos of 20 kw, is supplied with current by an 80-amp, 250-volt dynamo used exclusively for the purpose. This exciting dynamo is direct connected to and driven by a 30-hp, 550-volt induction motor operating at 720 r.p.m. Four induction motors, each rated at 75 hp, 2,250 volts and 720 r.p.m., drive the 16 20-kw dynamos, four of these dynamos being direct-connected to each motor.

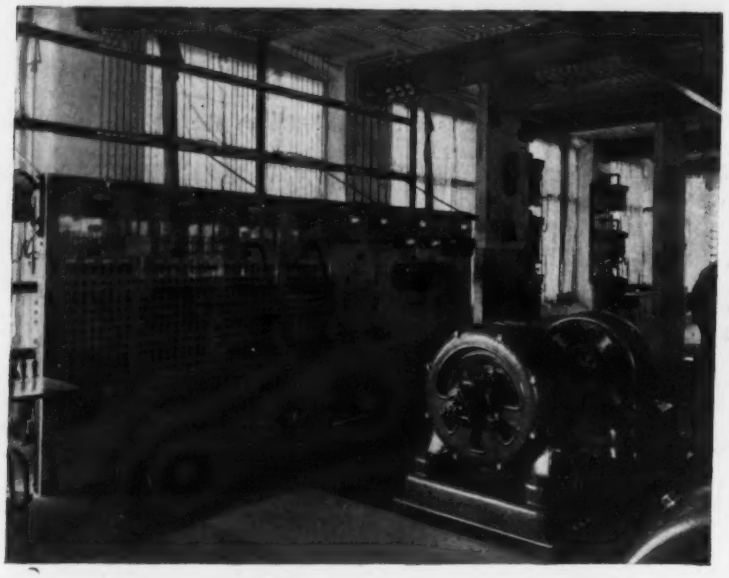


FIG. 2.—MOTOR-DRIVEN EXCITER AND SWITCHBOARD.

The four 75-hp motors and the 30-hp motor, just named, operate with their connected dynamos at constant speed. The voltage of the 80-amp, 250-volt exciting dynamo is held constant, and this voltage is maintained at the terminals of the magnet windings of each of the 25-hp motors that are belted to the printing machines. In the circuit of the magnet winding of each of the 16 20-kw dynamos that operate the 25-hp motors there is connected a rheostat of 51 contact segments, and this rheostat is located close to the printing machine that is driven by the motor which the 20-kw dynamo in question supplies. By this arrangement each operator, while standing at his printing machine, can vary its speed through wide limits by shifting the handle of his rheostat. As the handle of any rheostat is moved in the way that puts more resistance into the magnet winding of its dynamo the voltage at the terminals of this magnet winding drops. This causes a decrease in the voltage developed by the armature of the dynamo and delivered to the motor armature which this dynamo supplies.

Following the lower voltage at the motor armature comes a decrease in its speed which may be carried down to any point within the range afforded by the rheostat. A reverse operation, that is manipulation of the rheostat in a way to decrease the resistance in the circuit of the magnet winding on a dynamo, raises the voltage of the dynamo armature and also the voltage at the terminals of the armature of its motor, thus increasing the motor speed. While these speed changes are in progress the armature of a dynamo is able to deliver its full rated current of 80 amp, and the motor armature receiving this current and located in a constant magnetic field operates with uniform torque. Each of the 16 dynamos devoted to motor operation is wound with a magnet coil in series with its armature, in addition to the coil that is separately excited and in which the variable resistance of the rheostat is located. This series magnet coil, taking the entire armature current, probably tends to keep down sparking at the dynamo commutator during any rapid increase in the volume of armature current, especially when the exciting power of the separately excited magnet coil is low. Formerly the dynamos supplying motors were used with only the separately excited magnet coils, but operation has been more satisfactory since the series coils were added to the dynamo magnets.

In order to show the extent of speed regulation attained by the method just described, also the changes in voltage at the dynamo magnet windings and motor armatures by which this regulation is effected, the following results of a speed test at the roller of one of the printing machines are given. As may be noted, the printing roller increased in speed from 1¼ to 19 r.p.m., while the rheostat handle was shifted from segment No. 1 to 51. This shows a gain of 17.75 revolutions for the printing cylinder during 50 movements of the rheostat arm, or an increase of only .355 revolutions on an average for each of the 50 steps. As the motor armature was mechanically connected by belt and gears with the cylinder of the printing machine, it may be assumed that the speeds of the cylinder and the motor armature varied together. While the speed of the cylinder went up from 1¼ to 19, or 15.2 times, the voltage at the terminals of the motor armature increased from 26 to 315, or 12.1 times. With constant strength of motor magnet the speed of its armature should increase directly with the voltage at its terminals, provided that the amperes flowing through the armature are constant.

From the figures just quoted it appears that the current in the motor armature must have declined with the rising speed. Influence of the series coil on the dynamo magnet is notable in the record of volts at the separately excited magnet coil on the dynamo magnet, and at the motor armature. While the volts at the separately excited coil of the dynamo magnet rose from 2 to 250, or 125 times, the volts at the motor armature increased from 26 to 290, or only

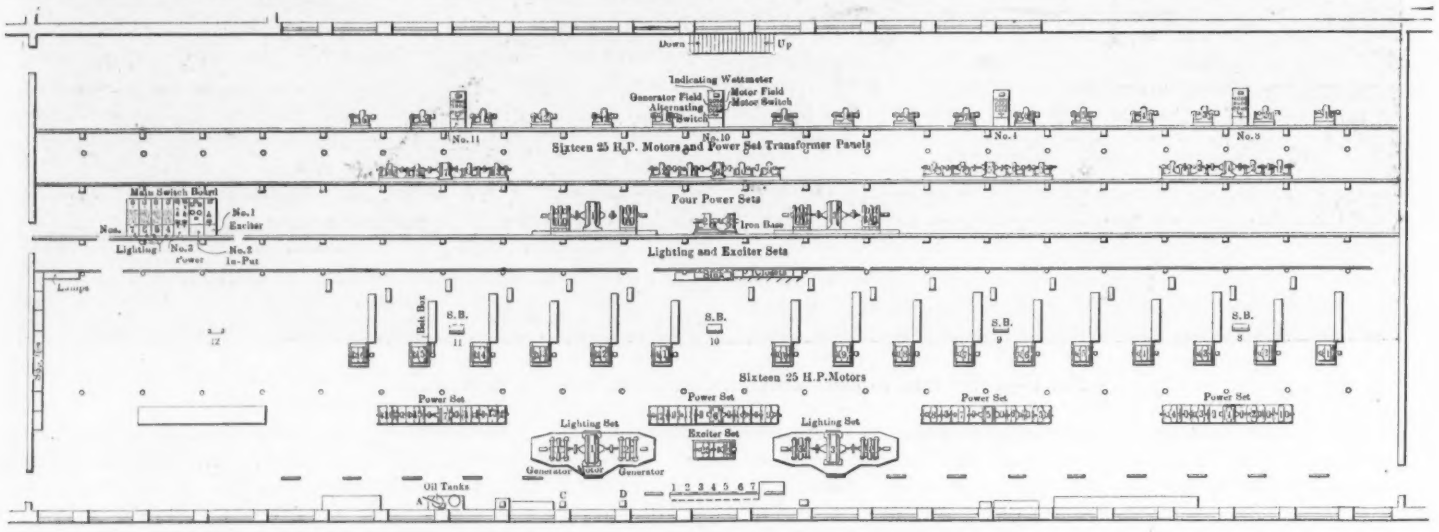


FIG. 3.—ELEVATION AND PLAN OF MANCHESTER MILLS PLANT.

11 times. This rapid rise of voltage generated by the dynamo armature and delivered to the motor armature is more than can be accounted for by the changes of current in the separately excited coil of the dynamo magnet and by the changing permeability of this magnet. The magnetizing action of the series coil is the other force necessary to produce the recorded results.

As has been seen, all the power for the operation of the 16 printing machines, with their 16 belted motors and 16 dynamos, is derived from the 4 induction motors of 75 hp each, and 1 induction motor of 30 hp. Connected to the same wattmeter with the five

motors just named is 1 of 15 hp and 1 of 1 hp, making the total capacity of motors which receive energy through this meter 346 hp. Of this capacity, 330 hp, or 95 per cent., is devoted to the operation of the printing machines. Knowing the amount of energy consumed by these motors during a definite period with the printing sets at work, an approximate idea of the efficiency of these sets and of their method of speed regulation can be obtained. During 260 hours of working time for the 346 hp of motors just considered, these motors absorbed 19,740 kw-hours, the equivalent of 26,461 electric hp-hours. At their full rated capacity of 346 hp, these motors would deliver $346 \times 260 = 89{,}960$ hp-hours of work during 260 hours of operation. Comparing this possible delivery of work

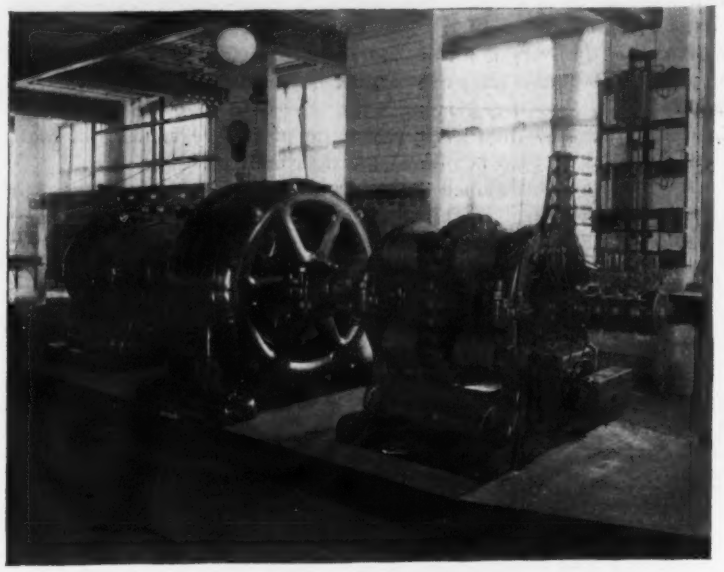


FIG. 4.—200-HP INDUCTION MOTOR DRIVING ARC DYNAMO.

at full load and maximum speed with the energy actually absorbed by the motors, it appears that the latter was only 29.4 per cent. of the former, though the speeds were varied through a wide range.

This electrical equipment at Manchester Mills is a striking illustration of the extent to which electric water power systems may operate large manufacturing plants. The adoption of variable-dynamo voltage for motor speed control on so large a scale is also notable. All of the transformers, motors and dynamos above mentioned, with the necessary instruments, were furnished by the General Electric Company.

For the facts here given relative to this interesting plant especial thanks are due to Mr. H. Schaeffer, superintendent of the print works, and to Mr. F. L. Clarke, the electrical engineer of the plant.

Ampere-Hour Capacity of the Lead Storage Battery.

BY A. L. MARSH.

IN this article it is intended to deal only with active materials, and more particularly with the positive active material, lead peroxide. The theoretical ampere-hour capacity of lead peroxide, per pound of material, may be calculated from the formula, $C = \frac{12145.552}{W}$, where C is the capacity in amp-hours per pound, W is the chemical equivalent of the substance, and 12145.552 is a constant. In the case of lead peroxide, assuming the compound to have the simple composition represented by the formula, PbO_2, $W = 119.46$. Therefore, the compound, PbO_2 will theoretically give 101.8 amp-hours per pound.

It is interesting to note how closely this figure has been approached by cells designed for commercial purposes. In order to bring out this point in a particular case, the following test was made on a cell designed for automobile use. The cell was not made especially for the test, but was taken at random from the stock of a well-known manufacturing concern. Both the positive and negative plates were of the pasted type. The size of the cell (outside dimensions) was 5¼ in. by 6 1/16 in. by 10 in. high, and weighed, complete, 35 pounds. There were 10 positive plates and 11 negatives. The positive grids weighed 8 ounces each and the weight of the active material averaged 10 ounces for each grid. The total positive active material, then, weighed 100 ounces, or 6.25 pounds.

The discharge curve shown in the figure was for a constant current of 11 amp, lasting for 24 hours and 45 minutes. This gives a total of 272.25 amp-hours. The superficial area of all the positive plates was 5.5 sq. ft., so the discharge was at the rate of 2 amp per sq. ft. This rate also corresponds to 1.76 amp per pound of positive active material, or about 1 amp per pound of positive plates. The average voltage of discharge was 2.07. The ampere-hour capacity per pound of complete cell was 7.8 and the watt-hour capacity was 16.1. This low rate of discharge is favorable to obtaining a high capacity from a cell, it being a well-known fact that the efficiency of a cell is much higher at low rates of discharge than at high rates.

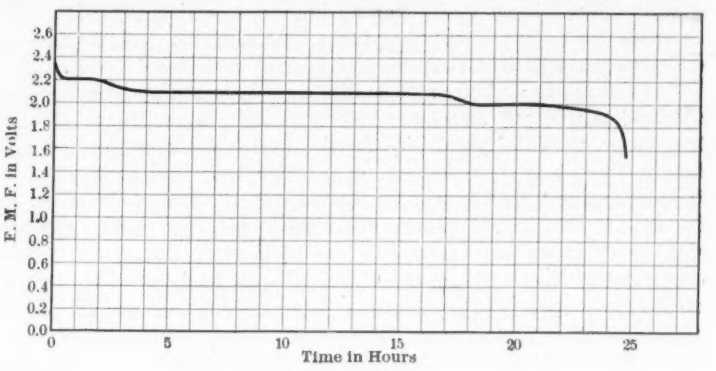
Since one pound of lead peroxide should give 101.8 amp-hours, the total positive active material (6.25 pounds) should give 636.25 amp-hours. The cell gave 272.25 amp-hours, so the actual capacity was 42.8 per cent. of the theoretical.

The same cell gave 200 amp-hours at a 4-hour discharge rate. This represents an amp-hour capacity of 31.4 per cent. of the theoretical. A part of the data given above is here tabulated for convenience in reference:

Weight of cell (complete)	35 lbs.
Weight of positive active material	6.25 lbs.
Rate of discharge	11 amperes.
Time of discharge	24 hours and 45 minutes.
Average voltage	2.07
Total ampere-hours	272.25
Ampere-hours per pound of complete cell	7.8
Watt-hours per pound of complete cell	16.1
Theoretical amp.-hrs. capacity per pound of PbO_2	101.8
Total active material of cell should give 636.25 amp.-hrs.	
Total active material of cell actually gave 272.25 amp.-hrs.	
Ampere-hour capacity at 25-hr. rate is 42.8% of ideal.	
Number of ampere-hours given at 4-hr. rate	200.
Ampere-hour capacity at 4-hr. rate is 31.4 % of ideal.	

Assuming the hypothesis of Wade to be correct, the ideal amp-hour capacity of lead peroxide becomes reduced to 50 per cent. of that given (101.8 amp-hours per pound). At the 25-hour rate, then, the cell actually gave about 86 per cent. of what was possible for it to give. The cell at the time this discharge was made had not reached its greatest capacity, for it had been given less than a dozen charges and discharges after the forming process had been discontinued. In practice, the forming process is seldom, if ever, allowed to continue until the active material is completely formed, so the cell has to be "worked" for some time before it reaches its point of greatest capacity.

The number of amp-hours given at the 25-hour rate represents a very fair capacity, though no doubt it can be improved upon. The amp-hour capacity at the 4-hour rate of discharge, however, leaves more to be desired, it being only about 63 per cent. of what is perhaps possible to obtain. This figure is not bad, considering the small amount of scientific work done in the development of the storage battery. At best there is, of course, a great deal of hit and miss experimenting necessary in the development of a complicated apparatus like the storage cell, but there is an opportunity for intelligent guessing or, if you prefer, a display of judgment in the selection of experiments to be tried, such that a chemist and physicist is better able to exercise than an electrical engineer.



DISCHARGE CURVE.

The above test, as well as many others, shows that batteries made for actual service will give an ampere-hour capacity approaching 50 per cent. of the calculated value if the discharge rate is low. The

principal problem, then, seems to be to obtain this high capacity for high rates of discharge. The logical and generally accepted way to accomplish this result is to make the active material more readily available to voltaic action by increasing the porosity of the active mass. By porosity is not meant that the mass should be full of large holes; for large openings take up a great deal of space and help but little towards the desired result. The invisible pores are the ones that count. They break up the mass so as to expose a very great surface to the action of the electrolyte, and should be of just sufficient size to hold the acid necessary for the proper discharge of the surrounding surface. The term "molecular porosity" has been used in this connection and perhaps best defines the ideal condition. This porosity combined with mechanical strength ought to permit of efficient discharges at high rates and at the same time greatly increase the life of the battery. There are materials found in nature that are very strong and very porous. It seems possible that these conditions may be realized for lead peroxide, though the nature of the peroxide may make the solution of the problem rather difficult.

The grid of the cell used in the above test was one of a lead-antimony alloy and proved to be very durable in service. As the figures show, the weight of the grid was a little less than half the weight of the entire plate. From the weakness of lead we can hardly expect a considerabe decrease in the percentage weight of the grid without a corresponding decrease in the life of the cell.

Only about half the weight of the positive plate is active material and, according to theory and practice, only about half of the positive material is really active. About the same conditions prevail for the negative plates. About three-fourths of the weight of the plates is, therefore, dead weight. Then there must be considered the electrolyte, lugs, connectors and containing cells, so the capacity of the lead cell, per pound of total weight, must necessarily be low. The cell used in the above test contained 6.25 pounds of lead peroxide. Assuming 50 per cent. of this weight to be active, we have about 3 pounds of really active positive material from which it may be possible to obtain 318 amp-hours, although only 272 amp-hours were obtained in the test. Approximately the same weight of negative material is necessary to give this discharge of 318 amp-hours. In order for the six pounds of active material to give its current it must be accompanied, according to the data for the above described cell, by a weight of material about five times greater than itself.

The proportion of dead weight in the lead cell seems to be rather great, and no doubt this has led many inventors to believe that the weight of the cell for a given output could be materially reduced. However, the grid cannot be made much lighter without sacrificing the life of the cell; the sulphuric acid electrolyte is necessary for the discharge and cannot safely be reduced in amount below that used in the present automobile cells; the weight of the hard rubber containing cell is so small that no important saving in weight can be made here; the connectors must be about the weight used in order to get sufficient strength and current-carrying capacity.

But since at the 4-hour rate of discharge only 200 amp-hours were obtained where 318 amp-hours were possible according to Wade's hypothesis, the chief possibility for the improvement of the lead cell lies in the active material. It is possible that Wade's hypothesis is incorrect and that by proper methods more than 50 per cent. of the active material may be made useful in giving current. Certain solid deporalizers in primary cells can be used up closer than 50 per cent., and if this could be accomplished with lead peroxide, the increased capacity of the lead storage battery would be considerable.

I think the figures given above show clearly that improvements in the lead storage battery are to be accomplished along the line just indicated, which line has been pointed out before by myself and others.

A Correction.

The article which appeared in the issue of Electrical World and Engineer of January 17, entitled "The Largest Electric Water Power System in New England," contains two errors, as follows: On page 106 the voltage of the generators at Garvin's Falls is stated to be 1,200 instead of 12,000; and on page 107 near the head of the second column, the size of the conductors of the three-phase circuits is given as "No. 1/10" instead of No. 1-0.

An Arrangement of Power Stations for Operating Steam Railways Electrically.

By C. J. Spencer.

Several steam railroads are considering the question of electric operation. These roads present some features that are different from the ordinary trolley system, in that they have their own right of way and much adjoining ground, they carry coal or can readily obtain it, and transport it to any location along their tracks; they have numerous sources of water supply, and they have a large force of employees at the various passenger stations. The trolley systems consist of many roads, the greater part of which are over thickly settled and consequently valuable land, they are on public streets and the owners must buy additional property for the power stations; they do not carry coal, and have no facilities for transporting it; they must create the necessary sources of water supply, and they do not have passenger stations.

The advantages gained by the trolley systems in generating current in one central station at high voltage and distributing to substations for conversion into current available for operating the cars, are saving in real estate, the one generating station taking less room than several small ones; saving in cost of carrying coal, the slight loss in the transmission line allowing the station to be placed near a water front or railroad; saving in cost of water supply, since the station can be located near a cheap source; and saving in cost of attendance, the few large machines in one station requiring less attention than many small machines in several stations. Since the present steam railroads have an abundance of real estate, coal, water, and attendance, it is evident that the advantages gained by the central power station will be less for railroads than for trolley lines.

It might be claimed that the total capacity of the central station in engines and boilers need not be as great as the combined capacity of several smaller stations, owing to the fact that the maximum load on the central station is not as great as the sum of the maximum loads on the sub-stations; but when the load is of one kind, the peak load comes on all the substations at the same time, and the central station must have a capacity sufficient to supply the total load. Another distinctive feature of steam railroads is that they extend in one line for a considerable distance, while trolley systems are composed of several roads running parallel. There must therefore be a greater part of the load at a distance from the center of load in the case of steam railroads than in that of trolley systems.

If we accept the above as applicable to a steam railroad under consideration, then the advantages of the method of generating high-voltage alternating current in one central station and distributing this to sub-stations for conversion into direct current over the simpler and more direct method of generating direct current in several stations distributed along the road should be very thoroughly investigated before making a decision as to the best method. Considering the more favorable of the central station methods, that in which no raising transformers are employed in the generating station, the current being generated at high potential, the machines that must convert the potential energy of the coal into mechanical energy at the car axle are the boilers, engines, dynamos, lowering transformers, rotary converters or motor-generators, and car motors, making a total of seven machines in all to replace the boiler and engine of the locomotive.

This array of machines is startling to any one not brought up in the electrical profession, even before the tremendous and expensive switchboards and cables are mentioned. The electrical engineer is in great danger of extending too much of his energies towards controlling high voltages without sufficient investigation as to its advantages. Cables with 5-32 inch of rubber or insulators at $1 each amount to quite a large item for a transmission line of forty or fifty miles. Alternating-current motors are being tried, which, if successful, will reduce the cost of substations, though the low frequency adopted by one company should so increase the cost of transformers as to leave this open to question. The substation attendance cost will, however, be eliminated, which is a very considerable item. At the present time the 600-volt direct-current motor is the only one in general use for traction purposes, and it would be extremely unwise for any one to attempt to make two such innovations so radical as the operation of a steam railroad electrically and

the operation of a new type of motor for traction purposes at one time.

Let us therefore assume that the trains must be supplied with direct current at 600 volts, and investigate the method of generating and distributing the current. It may be considered an easy matter to estimate the cost of installing and operating a central station with substations, and similar costs for a system of distributed power stations for comparison; but the personal equation of the engineer enters so largely into any estimate he might make as to materially affect the result. For the reason that steam railroads present many features more advantageous to a distributed system of power stations than to a central station system, the writer believes that, in the near future, there will be several cases in which the central station system will be adopted when the distributed system of stations would be more desirable.

In applying electric traction to a typical steam railroad, I would recommend for consideration 600-volt direct-current generating stations spaced along the road approximately 10 miles apart, with storage batteries in the station and a storage battery plant between each two stations. This would require a length of distribution of but two and one-half miles for fluctuating loads and five miles for steady loads. Owing to the fluctuating character of the load, storage batteries would be essential. These have been condemned by many good engineers of late, for no other reason than because accurate records are kept of the losses incurred by their use. There is no other part of the station apparatus, of which records are kept of both the input and output. If these same engineers would keep as careful a record of the amount of coal burned when the storage batteries are in use and when running without them, they would change their views on the subject. The difference in core loss between a large and a small dynamo will more than make up for the storage battery loss. Besides this, the energy must be stored somewhere, which is in the boiler steam drums when a battery is not used, and a sudden heavy load has the effect of causing a rush of steam with consequent fall of steam pressure and much entrained water is carried over, thus diminishing the capacity of the engines at time of greatest load.

A battery, properly cared for, will easily reach 85 per cent efficiency when floating on the line. This amounts to a total efficiency of 92.5 per cent when the battery supplies one-half the load. The battery, besides increasing the efficiency of the plant and saving the wear and tear on the engines, boilers and dynamos, costs only about one-half of what the same capacity in dynamos, engines and boilers cost. It will, besides, admit of overloading 100 per cent or more for a short time, while the dynamo will flash over or "buck" at a 50 per cent overload. The plant placed between generating stations is also cheaper than the cable required to transmit an uneven load with the same efficiency.

Suppose a feeder to this point must supply 720 kw-hours per day, the load being momentary and amounting to 1 hour total per day. Then, without the battery the cable must be designed to carry 720 kw. Let the efficiency be 80 per cent, then the voltage at the generating station must be boosted up to 750 volts for a 600-volt system, and since the current is 1,200 amperes and the drop in potential 150 volts the cable resistance must be 0.125 ohm, which will require five 1,000,000-c.m. cables for a transmission of 30,000 ft. about five miles. In the case of the storage battery, the cable must be designed to carry 30 kw, or 720 kw-hours per day. Assume the voltage as being boosted to 750 volts as before and that the battery has an efficiency of 85 per cent, leaving 44 volts to be lost on the line. The current amounts to 50 amperes and the cable resistance must be 0.88 ohm, which requires one 700,000-c.m. cable. The weight of five 1,000,000-c.m. bare cables for 30,000 ft. is 472,500 lbs. The weight of 30,000 ft. of 700,000-c.m. cable is 65,700 lbs. The difference in weight, 406,800 lbs., will pay for the battery without allowing anything for the extra insulators or for increasing track bonds, which would be required if no battery is used. The part of the battery between stations costs one-third of the extra expenditure that would be required for station equipment without batteries, while the part of the battery in the station costs one-half of the expenditure that would otherwise be required.

Returning to the system of generating current, the greatest objection offered to installing several stations is the amount of reserve machinery considered necessary. No more reserve machinery would be necessary, however, than in the central station system, for if one plant is out of service the several stations on either side will supply the current, if the plants have a slightly drooping characteristic similar to the ordinary shunt-wound dynamo. By making the third-rail circuit of very low resistance and sacrificing the regulation, any number of plants can be made to supply almost equal portions of the load.

By the use of steam turbines and mechanical draft, a further advantage is gained, in that the plants may be made portable and moved to more advantageous points with change of traffic. This arrangement would not be greatly different from the present existing conditions, the difference being that the engines and boilers would be operated while stationary and at constant load, instead of when running at forty or fifty miles per hour with greatly varying loads. There would be no need of stopping the trains for coal supply, and the moving machinery would be less complicated and less liable to get out of order than the locomotive. With several motor cars per train, the probability of an accident so serious as to cause stoppage, would be very remote, and sharp curves could be passed at a higher speed than at present attained. The wear on the tracks, roadbed and bridges would be considerably reduced with the weight thus distributed. Then there is the greatest advantage of all to be gained by electric drive, the increased frequency of service.

It would then appear that these advantages gained by electrifying steam roads are sufficient, without trying to increase the efficiency by installing a high-voltage system, and thus neutralize all good results gained by having a breakdown in the central station and stop all traffic. With the distributed system of stations, there is but one part of the system to fail and thus stop a train, a third-rail section. With the central station there are three parts, the central station, the transmission line, and a third-rail section. Moreover, a failure of a vital part in the central station would stop all traffic, and a failure of a transmission line would stop a large part of the traffic, while a failure to the third-rail is as liable to happen as in the distributed station system.

It would therefore appear that there is little to be gained and a great deal to lose by applying the central station method of generating current to steam railroads.

The Shawinigan Plant.

On Saturday, February 7th, the Shawinigan Water & Power Company successfully started its power transmission plant between Shawinigan Falls and Montreal. The transmission line, which is of aluminum cable, is a fraction of over 84 miles in length. The transmission is at 50,000 volts, 30 cycles. The line has a maximum capacity of 8,000 hp. The apparatus at present installed is capable of delivering 2,500 hp, and additional apparatus is being put in as rapidly as possible for 2,500 hp more. The step-up and step-down transformers and switchboard apparatus were furnished by the Westinghouse Company and the synchronous frequency changers for changing from 30 to 60 cycles were furnished by the Bullock Company. This apparatus was all set up, ready for operation seven months from the date of the order for it. The 50,000-volt line insulators were furnished by the R. Thomas & Sons Company, of East Liverpool. The aluminum cable was supplied by the Pittsburg Reduction Company.

The station buildings for the transmission were designed by Mr. Wallace C. Johnson, chief engineer of the Shawinigan Water & Power Company, who also had in charge the carrying out of the construction work. The transmission was laid out and the construction directed by Mr. Ralph D. Mershon, consulting engineer for the company.

A New Street Car.

It is stated that a new type of street car is being made for the Twin City Rapid Transit Company, of St. Paul. Separate entrances and exits through the rear vestibule are contemplated, and a plan is being worked out for a means of ingress through the motorman's cab. Both the front and rear vestibules are to be lengthened a foot or two. A partition will divide these vestibules in half. At the right will be the entrance, and at the left the exit. Thus passengers may enter and leave the car without jostling. It is believed that with the separate entrances and exits the time for stops will be reduced by one-half, as there will be simultaneous movement on the part of passengers getting off and getting on.

The Construction of Aerial Telephone Lines—III*

By Arthur V. Abbott, C. E.

THE last section dealt with the various stresses upon poles. The next subject to be taken up is that of guying.

Guying.—Let *A B*, Fig. 6, be the vertical elevation of a pole, entering the ground at the point *B*, and let *A C* represent the resultant of all the stresses due to the tension of the circuits acting in the direction *A C*. To resist this tension it is customary to reinforce the pole by attaching a wire rope, or iron rod, in the neighborhood of the point *A* extending to the ground, or to some other point of attachment at a convenient distance from the pole at say *D*, as is shown at *Y*, Fig. 6. It is now required to determine the stresses on the guy *A D*, and on the pole *A B*, under the action of the force *A C*, in order that such a pole may be properly designed. The height of the pole *A B* is known, also the distance *B D* from the base of the pole to the point of attachment of the guy, and the stress, *A C*. To any convenient scale of pounds draw *A'C'* parallel to *A C*, and make *A'C'* equal to the resultant *A C* of all the tensions on the pole. From *A'* erect the perpendicular *A'D'*. Make the length of *A'D'* bear the same proportion to *A'C'* that *A B* does to *B D*, or in other words, divide the length of the pole *A B* between the application of the resultant and the ground by the distance *B D* from the base of the pole to the point at which the guy enters the ground, and multiply *A'C'* by this quotient to find the length of *A'D'*. This result is the compression in the pole. Connect the points, *C'D'*, then the length of the line *C'D'* to the same scale as *A'C'*, and *A'D'* will give the tension in the guy rod. For example,

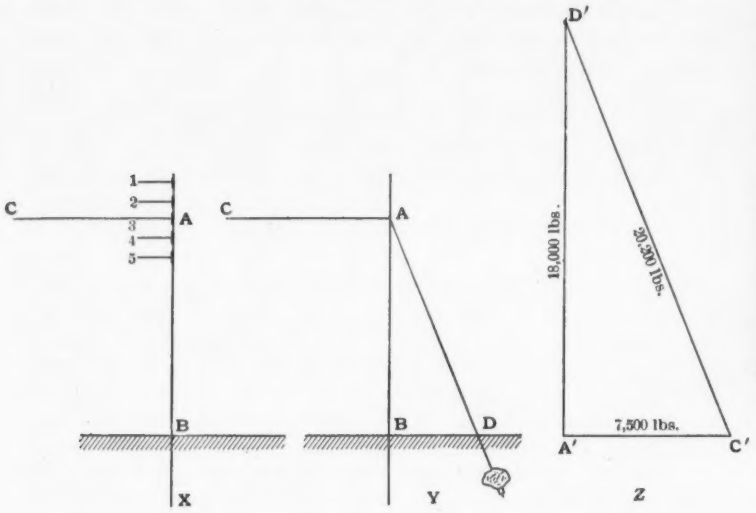
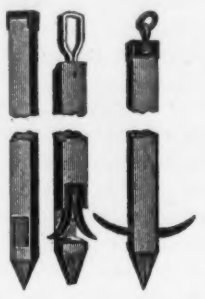


FIG. 6.—GUY DIAGRAM.

assume a 30-ft. pole line, carrying 5 ten-pin cross arms, or 50 wires, each stretched to a tension of 150 pounds. The resultant *A C* of the tension in all the wires will be 7,500 pounds, and the point of application, midway between the top and bottom arm at say 25 ft. from the ground. Suppose the guy to be set 10 ft. away from the base of the pole, then *A B* divided by *B D* gives 2.5. Fig. 6, *Z*, shows *A'C'* drawn to represent 7,500 pounds (scale 4,000 per inch). *A'D'* is made 2.5 times as long as *A'C'*, showing the compression in the pole to be 18,750 pounds, and *C'D'* is found to be 2.69 times as long as *A'C'*, giving 20,200 pounds (approximately) as the tension on the guy. The necessary size required for the pole is readily calculated by remembering that the pole is a column supported at the base, and the diameter may be obtained by the use of the preceding formulæ. As guys are always in tension it is usual to make them of wire rope, or iron rods, but it is necessary to remember that not only must the material of the guy itself be sufficiently strong to resist the stress applied upon it, but its attachment both to the pole and to the ground, or other object, must be sufficient to withstand all of the force applied. It is a common practice to fasten guys by bolting the end of the strand to a log of wood termed a "dead man," and burying it in the earth. Another, more modern, and in some respects more mechanical method, employs a device resembling an enormous auger, which can be screwed into clay or loam, and makes an excellent fastening in such soils. A still more recent device consists of a pointed iron pipe, which can be driven into the earth, and after it is set, one or more sharp spur-like grappling irons can be projected through the wall of the pipe into the earth. These devices are shown in Fig. 7.

Sometimes, especially in soils that are marshy or have quicksand it is usual to bolt the pole onto two long timbers, that form a base on which it may stand, and to the end of which the guy is attached. Now the pole may fail by overturning, and the timber foundation must hold weight enough of earth to prevent this. Take the example of Fig. 6. The tendency of the pole to tip over is measured by multiplying the height of the pole to the resultant (25 ft.) by the resultant of the line tension ($7{,}500 \times 25 = 187{,}500$ foot-pounds). This is called the moment of the force tending to overturn the pole. On the timbers bolted to the base of the pole rests a quantity of earth; the moment of which (its weight multiplied by the distance of its center of gravity from the pole) must be equal to or more than the overturning moment. The distance of the center of gravity of this earth from the base of the pole is half the distance of the guy



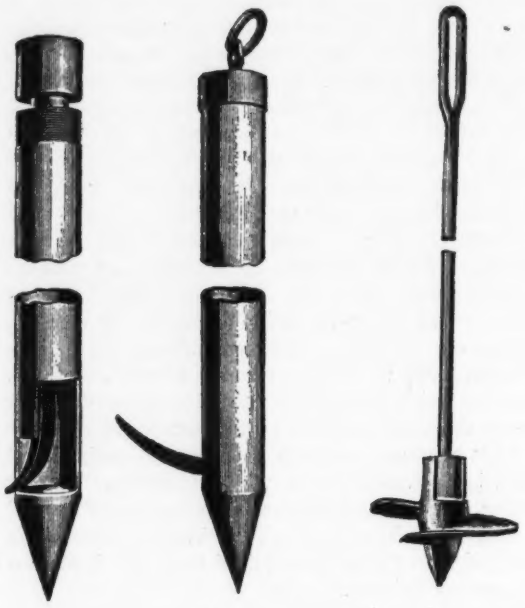


FIG. 7.—VARIOUS STYLES OF GUY ANCHORS.

from the pole, or in this example 5 ft., then the weight of the earth must be $\frac{187{,}500}{5}$, or 35,500 pounds. Earth weighs about 100 pounds per cubic foot, hence $\frac{33{,}200}{100} = 332$ cubic feet of earth are needed. Suppose the timbers to be 10 ft. long and buried 6 ft. below the surface, then the width of the timbers or the planking they carry must be $\frac{332}{10 \times 6} = 5.5$ ft. This will exactly balance the pole, but in addition a fair factor of safety should be allowed.

There are few parts of a telephone plant in which as many mistakes are made as in guying. Fig. 8 is an illustration of some of the methods in which guying has been done. At *A* the well-known form of Y-guying is illustrated, which is probably the best device of this nature. Here the upper portion of the guy is split into two parts, one of which is attached to the top of the pole and the other directly beneath the lower cross-arm. By this means there is less tendency for the tension in the circuits to bend the top of the pole than by any other method. Erroneous methods of guying are shown in the other four examples of this illustration, the difficulties to which they give rise being so self-evident that further explanation is unnecessary.

Anchor Poles.—City lines are called upon to carry large numbers of wires and cables, and it is often necessary either to turn very sharp corners or to terminate an entire line, at say its entrance to the underground system, so that poles must frequently resist very severe

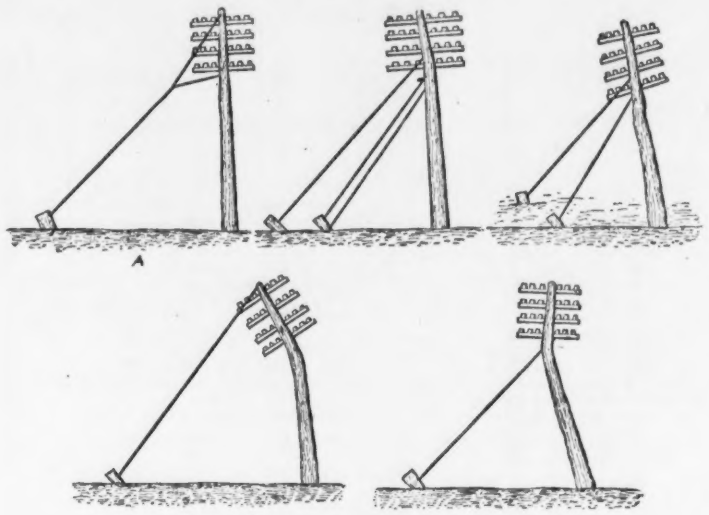


FIG. 8.—WRONG METHODS OF GUYING.

longitudinal stresses. A line upon which 80 or 100 wires terminate, carrying three or four cables, will be subjected to a stress at the top of 30,000 to 35,000 pounds, and poles designed to carry such tension, are termed "anchor poles." By far the neatest solution of this problem lies in the erection of a pole built of structural iron,

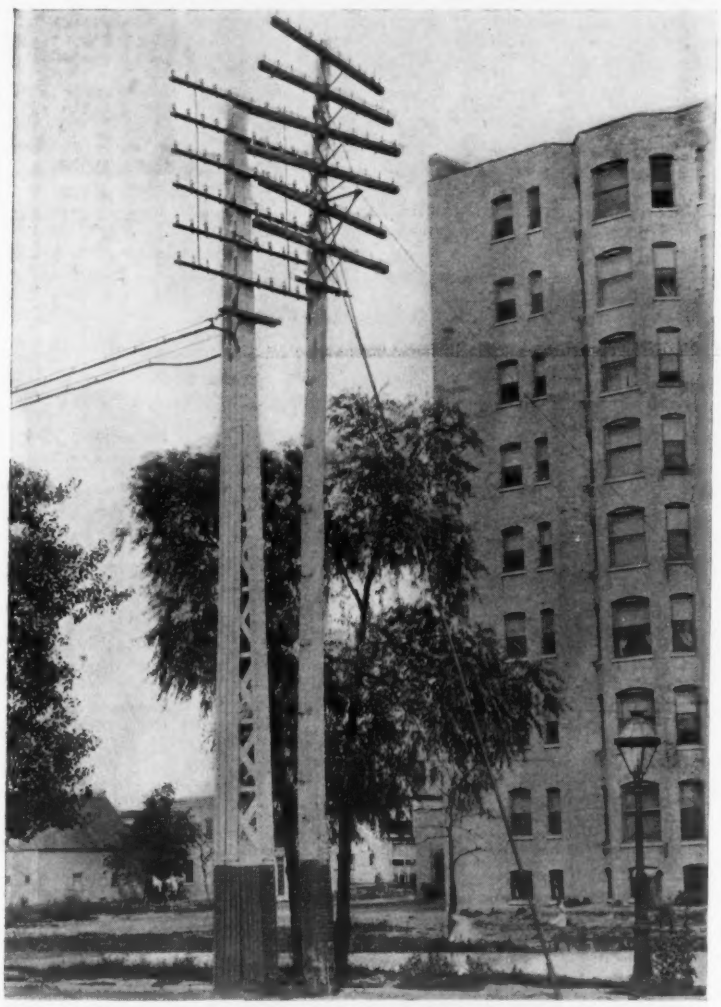


FIG. 9.—STRUCTURAL IRON POLE.

similar to that shown in Fig. 9. It is easy to design such a pole to carry any desired line stress, suitable for the most restricted location, of city streets and, withal, present even a pleasing architectural appearance. But poles of this kind are expensive, the one in the illustration costing upward of $500. As a compromise it is possible to reinforce a wooden pole in such a manner as to make it both structurally strong and of good appearance. This is accomplished by fitting the top of the pole with a lattice work of angles, stiff enough to transmit all the tension of the circuits to the guy rod without bringing an undue bending moment on the top of the pole. An illustration of the "composite anchor pole" is, as this device is termed, given in Fig. 10 and the details of construction shown in Figs. 11, 12, 13 and 14. Fig. 11 is the general elevation and ground plan of the entire structure. The pole may be any suitable stick of sufficient height, say 40 ft to 60 ft., to carry the lowest circuit at the requisite elevation above ground level. The top diameter should not be less than 10 inches and the diameter at the ground from 18 inches to 24 inches. As is shown in Fig. 11, the pole is framed into two yellow pine sticks shown in elevation at *B* and in plan at *D D*. These sticks carry a platform of 3-in. plank, as shown in the elevation. This platform serves to carry sufficient weight of earth to keep the pole from overturning. Table 4 shows the dimensions of the timber needed for various capacities of pole lines, the sizes given in the

TABLE 4.
DIMENSIONS OF ANCHOR PLATFORM.

Number of Cross-Arms.	Number of Cables.	A	B	C	D	E	F	G
4	0	12′0″	20′0″	12″	8″	6′0″	6″	12″
6	0	12′0″	20′0″	12″	8″	6′0″	6″	12″
8	0	13′0″	22′0″	12″	10″	8′0″	8″	12″
10	0	13′0″	22′0″	12″	10″	8′0″	8″	12″
4	1	12′0″	20′0″	12″	8″	6′0″	6″	12″
6	1	13′0″	22′0″	12″	10″	8′0″	8″	12″
8	1	13′0″	22′0″	12″	10″	8′0″	8″	12″
10	1	14′0″	24′0″	12″	12″	10′0″	10″	12″
4	2	13′0″	22′0″	12″	10″	8′0″	8″	12″
6	2	13′0″	22′0″	12″	10″	8′0″	8″	12″
8	2	14′0″	24′0″	12″	12″	10′0″	10″	12″
10	2	14′0″	24′0″	12″	12″	10′0″	10″	12″
4	3	13′0″	22′0″	12″	10″	8′0″	8″	12″
6	3	13′0″	22′0″	12″	10″	8′0″	8″	12″
8	3	14′0″	24′0″	12″	12″	10′0″	10″	12″
10	3	14′0″	24′0″	12″	12″	10′0″	10″	12″

columns headed *A B*, etc., refer to the dimensions of Fig. 11 designated with the same letter. On the top of the pole a simple lattice of angle iron is placed, made as shown in Fig. 12. This lattice should reasonably fit the top of the pole and be long enough to cover the entire space occupied by the cross-arms. At proper intervals a transverse angle iron is rivetted to the lattice to hold the cross-arms. Fig. 12 is a detail drawing of the various sizes of lattice needed, while all dimensions are given in Table 5. As is seen in Fig. 10, the lattice is placed on the back of the pole; i. e., is away from the direction in which the circuits extend and secured by iron bands. The guy is a Y-guy and also secured by iron bands which encircle both pole and lattice. An enlarged cross section and side

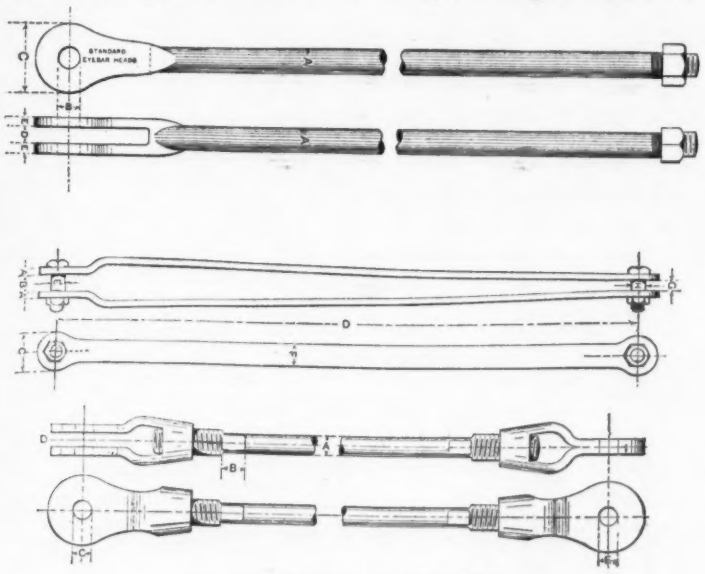


FIG. 14.—DETAILS OF GUY RODS.

elevation of the bands appears in Fig. 13. Table 6 gives dimensions for guy rod bands and Table 7 data for pole bands. The guy rod consists of an iron rod with a nut at the lower end to attach it beneath the earth platform, and a clevis at the upper end, to which the guy rod bands are attached, as shown in Fig. 10. Fig. 14 gives

TABLE 5.

DIMENSION OF POLE LATTICES. POSITION OF GUY-ROD BANDS.

No. of Cross-Arms.	No. of Cables.	Size of Angle Iron.	Weight of Angle Iron in lbs., per foot.	No. of Angles.	Length of Angles.	Lattice. Wide. A	Lattice. Wide. B	Thick. C	Thick. D	Upper Band.	Lower Band.	No. of Clamping Bands.
4	0	6"x3½"x⅜"	11.7	2	12'0"	..	..	3"	¼"	Midway between 2d and 3d arm		2
6	0	7"x3½"x7/16"	15	2	12'0"	..	..	3"	¼"	Midway between 3d and 4th arm		2
8	0	6"x3½"x⅜"	11.7	2	18'0"	..	..	3"	¼"	Midway between 2d and 3d arm	Midway between 6th and 7th arm	3
10	0	7"x3½"x7/16"	15	2	21'0"	..	..	3"	¼"	Just above 3d arm	Just below 8th arm	3
4	1	7"x3½"x7/16"	15	2	12'0"	..	..	3"	¼"	Just below 3d arm		2
6	1	6"x3½"x⅜"	11.7	2	12'0"	..	..	3"	¼"	Midway between 2d and 3d arm	Just below 6th arm	2
8	1	7"x3½"x7/16"	15	2	18'0"	..	..	3"	¼"	Just below 3d arm	Just below 8th arm	3
10	1	7"x3½"x7/16"	15	2	21'0"	..	..	3"	¼"	Midway between 3d and 4th arm	Midway between 9th & 10th arm	3
4	2	6"x3½"x⅜"	11.7	2	12'0"	..	..	3"	¼"	Just above 2d arm	Midway between 4th & cable-arm	2
6	2	6"x3½"x⅜"	11.7	2	12'0"	..	..	3"	¼"	Midway between 3d and 4th arm	Midway between 6th & cable-arm	2
8	2	7"x3½"x7/16"	15	2	18'0"	..	..	3"	¼"	Just below 3d arm	Just below 8th arm	3
10	2	7"x3½"x9/16"	24.9	2	21'0"	..	..	3"	¼"	Just above 4th arm	Just above 10th arm	3
4	3	6"x3½"x⅜"	11.7	2	12'0"	..	..	3"	¼"	Just above 2d arm	Just above cable-arm	2
6	3	7"x3½"x7/16"	15	2	18'0"	..	..	3"	¼"	Midway between 3d and 4th arm	Midway between 6th and cable-arm	2
8	3	7"x3½"x9/16"	24.9	2	18'0"	..	..	3"	¼"	Midway between 3d and 4th arm	Just below 8th arm	3
10	3	7"x3½"x9/16"	24.9	2	21'0"	..	..	3"	¼"	Just above 4th arm	Just below 10th arm	3

TABLE 6.

DATA FOR GUY ROD BANDS.

No. of Cross-Arms	No. of Cables.	Upper Band. A	B	C	D	E	F	G	H	I	K	L	M	N	O	Lower Band. A	B	C	D	E	F	G	H	I	K	L	M	N	O	Rivets.
4	0	..	..	⅜	1⅜	1⅜	¾	..	4¼	1¾	5¼	1⅜	12	7	3½	..	..	..	..	..	..	..	..	..	..	..	..	..	..	¾
6	0	..	..	⅜	1⅜	1⅜	¾	..	5¾	2	6½	1⅜	12	8	4	..	..	..	..	..	..	..	..	..	..	..	..	..	..	¾
8	0	..	..	⅜	1⅜	1⅜	¾	..	4¼	1½	5¼	1⅜	12	7	3½	..	..	⅜	1⅜	1⅜	¾	..	4¼	1½	5¼	1⅜	12	7	3½	¾
10	0	..	..	⅜	1⅜	1⅜	¾	..	4¾	1¾	5¾	1⅜	12	7	3½	..	..	⅜	1⅜	1⅜	¾	..	4¾	1¾	5¾	1⅜	12	7	3½	¾
4	1	..	..	⅜	1⅜	1⅜	¾	..	5¾	2	6½	1⅜	12	8	4	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	¾
6	1	..	..	⅜	1⅜	1⅜	¾	..	4¼	1½	5¼	1⅜	12	7	3½	..	..	⅜	1⅜	1⅜	¾	..	4¼	1½	5¼	1⅜	12	7	3½	¾
8	1	..	..	⅜	1⅜	1⅜	¾	..	4¾	1¾	5¾	1⅜	12	7	3½	..	..	⅜	1⅜	1⅜	¾	..	4¾	1¾	5¾	1⅜	12	7	3½	¾
10	1	..	..	⅜	1⅜	1⅜	⅞	..	4¾	1⅞	6	1⅜	12	7	3½	..	..	⅜	1⅜	1⅜	⅞	..	4¾	1⅞	6	1⅜	12	7	3½	¾
4	2	..	..	⅜	1⅜	1⅜	¾	..	4¼	1½	5¼	1⅜	12	7	3½	..	..	⅜	1⅜	1⅜	¾	..	4¼	1½	5¼	1⅜	12	7	3½	⅞
6	2	..	..	⅜	1⅜	1⅜	¾	..	4¾	1¾	5¾	1⅜	12	7	3½	..	..	⅜	1⅜	1⅜	¾	..	4¾	1¾	5¾	1⅜	12	7	3½	¾
8	2	..	..	⅜	1⅜	1⅜	¾	..	4¾	1⅞	6	1⅜	12	7	3½	..	..	⅜	1⅜	1⅜	⅞	..	4¾	1⅞	6	1⅜	12	7	3½	¾
10	2	..	..	⅜	1½	1½	1	..	6	2⅛	7	1½	12	8	4	..	..	⅜	1½	1½	1	..	6	2⅛	7	1½	12	8	4	⅞
4	3	..	..	⅜	1⅜	1⅜	¾	..	4¼	1½	5¼	1⅜	12	7	3½	..	..	⅜	1⅜	1⅜	¾	..	4¼	1½	5¼	1⅜	12	7	3½	1
6	3	..	..	⅜	1⅜	1⅜	⅞	..	4¾	1¾	5¾	1⅜	12	7	3½	..	..	⅜	1⅜	1⅜	⅞	..	4¾	1¾	5¾	1⅜	12	7	3½	¾
8	3	..	..	⅜	1½	1½	1	..	6	2⅛	7	1½	12	8	4	..	..	⅜	1½	1½	1	..	6	2⅛	7	1½	12	8	4	⅞
10	3	..	..	⅜	1⅝	1⅝	1	..	6½	2⅜	7½	1⅝	12	8	4	..	..	⅜	1⅝	1⅝	1	..	6½	2⅜	7½	1⅝	12	8	4	1

TABLE 7.

DATA FOR POLE BANDS.

No. of Cross-Arms.	No. of Cables.	Upper Band. A	B	C	D	E	F	G	H	I	K	Middle Band. A	B	C	D	E	F	G	H	I	K	Lower Band. A	B	C	D	E	F	G	H	I	K
4	0	..	..	⅜	1⅜	1⅜	¾	..	1⅜	9	6	..	..	..	..	..	..	..	..	..	..	..	..	⅜	1⅜	1⅜	¾	..	1⅜	12	6
6	0	..	..	⅜	1⅜	1⅜	¾	..	1⅜	9	6	..	..	..	..	..	..	..	..	..	..	..	..	⅜	1⅜	1⅜	¾	..	1⅜	12	6
8	0	..	..	⅜	1⅜	1⅜	¾	..	1⅜	9	6	..	..	⅜	1⅜	1⅜	¾	..	1⅜	12	6	..	..	⅜	1⅜	1⅜	¾	..	1⅜	12	6
10	0	..	..	⅜	1⅜	1⅜	¾	..	1⅜	9	6	..	..	⅜	1⅜	1⅜	¾	..	1⅜	12	6	..	..	⅜	1⅜	1⅜	¾	..	1⅜	12	6
4	1	..	..	⅜	1⅜	1⅜	¾	..	1⅜	9	6	..	..	..	..	..	..	..	..	..	..	..	..	⅜	1⅜	1⅜	¾	..	1⅜	12	6
6	1	..	..	⅜	1⅜	1⅜	¾	..	1⅜	9	6	..	..	..	..	..	..	..	..	..	..	..	..	⅜	1⅜	1⅜	¾	..	1⅜	12	6
8	1	..	..	⅜	1⅜	1⅜	¾	..	1⅜	9	6	..	..	⅜	1⅜	1⅜	¾	..	1⅜	12	6	..	..	⅜	1⅜	1⅜	¾	..	1⅜	12	6
10	1	..	..	⅜	1⅜	1⅜	¾	..	1⅜	9	6	..	..	⅜	1⅜	1⅜	¾	..	1⅜	12	6	..	..	⅜	1⅜	1⅜	¾	..	1⅜	12	6
4	2	..	..	⅜	1⅜	1⅜	¾	..	1⅜	9	6	..	..	..	..	..	..	..	..	..	..	..	..	⅜	1⅜	1⅜	¾	..	1⅜	12	6
6	2	..	..	⅜	1⅜	1⅜	¾	..	1⅜	9	6	..	..	..	..	..	..	..	..	..	..	..	..	⅜	1⅜	1⅜	¾	..	1⅜	12	6
8	2	..	..	⅜	1⅜	1⅜	¾	..	1⅜	9	6	..	..	⅜	1⅜	1⅜	¾	..	1⅜	12	6	..	..	⅜	1⅜	1⅜	¾	..	1⅜	12	6
10	2	..	..	⅜	1⅜	1⅜	¾	..	..	..	..	9	6	8⁄16 1	..	1⅜	¾	..	1⅜	12	6	..	..	⅜	1⅜	1⅜	¾	..	1⅜	12	6
4	3	..	..	⅜	1⅜	1⅜	¾	8⁄16 1	8⁄16	..	..	9	6	8⁄16 1	..	..	..	..	..	..	..	..	..	⅜	1⅜	1⅜	¾	..	1⅜	12	6
6	3	..	..	⅜	1⅜	1⅜	¾	..	1⅜	9	6	..	..	..	..	..	..	..	..	..	..	..	..	⅜	1⅜	1⅜	¾	..	1⅜	12	6
8	3	..	..	⅜	1⅜	1⅜	¾	..	1½	9	6	..	..	⅜	1⅜	1⅜	¾	..	1⅜	12	6	..	..	⅜	1⅜	1⅜	¾	..	1⅜	12	6
10	3	..	..	⅜	1⅜	1⅜	¾	..	1⅜	9	6	..	..	⅜	1⅜	1⅜	¾	..	1⅜	12	6	..	..	⅜	1⅜	1⅜	¾	..	1⅜	12	6

TABLE 8.

MAIN GUY ROD.

No. of Cross-Arms.	No. of Cables.	A	B	C	D	E
4	0	1⅝"	2½"	7"	1½"	¾"
6	0	1⅞"	2½"	7"	1¾"	¾"
8	0	2"	2½"	7"	1½"	⅞"
10	0	2"	2½"	7"	1½"	⅞"
4	1	1⅞"	2½"	7"	1¾"	¾"
6	1	2"	2½"	7"	1½"	⅞"
8	1	2"	2½"	7"	1½"	⅞"
10	1	2¼"	2½"	7"	1½"	⅞"
4	2	2"	2½"	7"	1½"	⅞"
6	2	2"	2½"	7"	1½"	⅞"
8	2	2¼"	2½"	7"	1½"	⅞"
10	2	2½"	3"	7 13/16"	1¾"	1"
4	3	2"	2½"	7"	1½"	⅞"
6	3	2"	2½"	7"	1¾"	⅞"
8	3	2½"	3"	7 13/16"	1¾"	1"
10	3	2⅞"	3½"	9½"	2¼"	1"

TABLE 9.

BRANCHES FOR GUY ROD.

No. of Cross-Arms.	No. of Cables.	A	B	C	D	E
4	0	1⅝"	2½"	7"	1½"	¾"
6	0	1⅞"	2½"	7"	1¾"	¾"
8	0	2"	2½"	7"	1½"	⅞"
10	0	2"	2½"	7"	1½"	⅞"
4	1	1⅞"	2½"	7"	1¾"	¾"
6	1	2"	2½"	7"	1½"	⅞"
8	1	2"	2½"	7"	1½"	⅞"
10	1	2¼"	2½"	7"	1½"	⅞"
4	2	2"	2½"	7"	1½"	⅞"
6	2	2"	2½"	7"	1½"	⅞"
8	2	2¼"	2½"	7"	1½"	⅞"
10	2	2½"	3"	7 13/16"	1¾"	1"
4	3	2"	2½"	7"	1½"	⅞"
6	3	2"	2½"	7"	1½"	⅞"
8	3	2½"	3"	7 13/16"	1¾"	1"
10	3	2⅞"	3½"	9½"	2¼"	1"

TABLES 5, 6, 7, 8 AND 9.—CONSTRUCTION OF AERIAL TELEPHONE LINES.

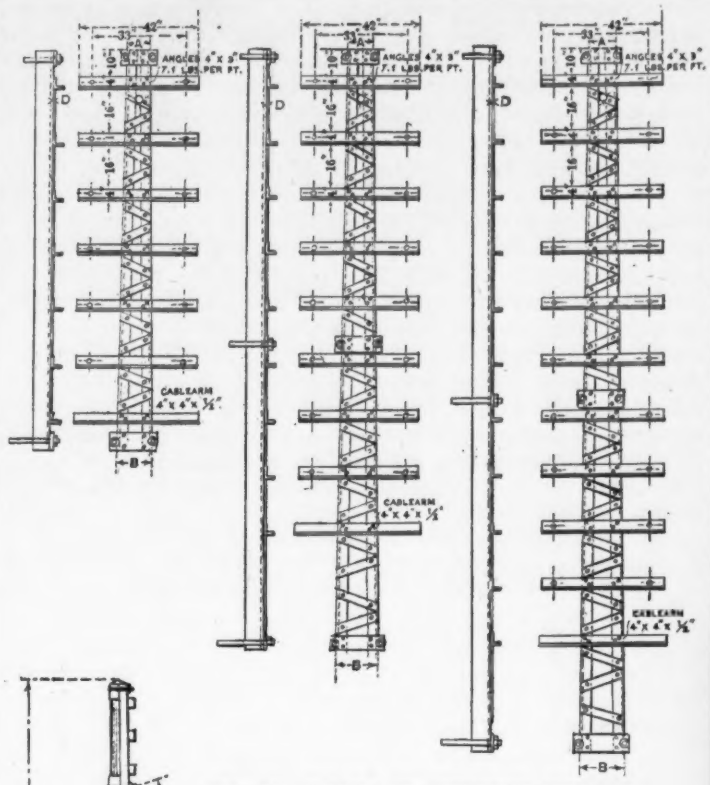


FIG. 12.—DETAILS OF COMPOSITE POLE TOP.

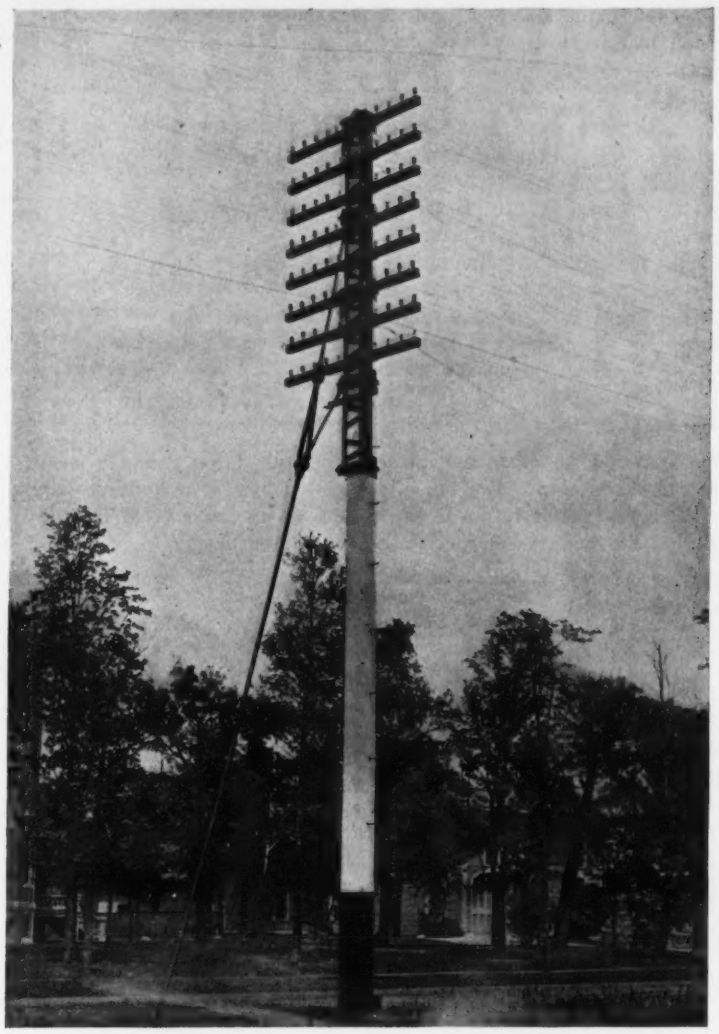


FIG. 10.—COMPOSITE ANCHOR POLE.

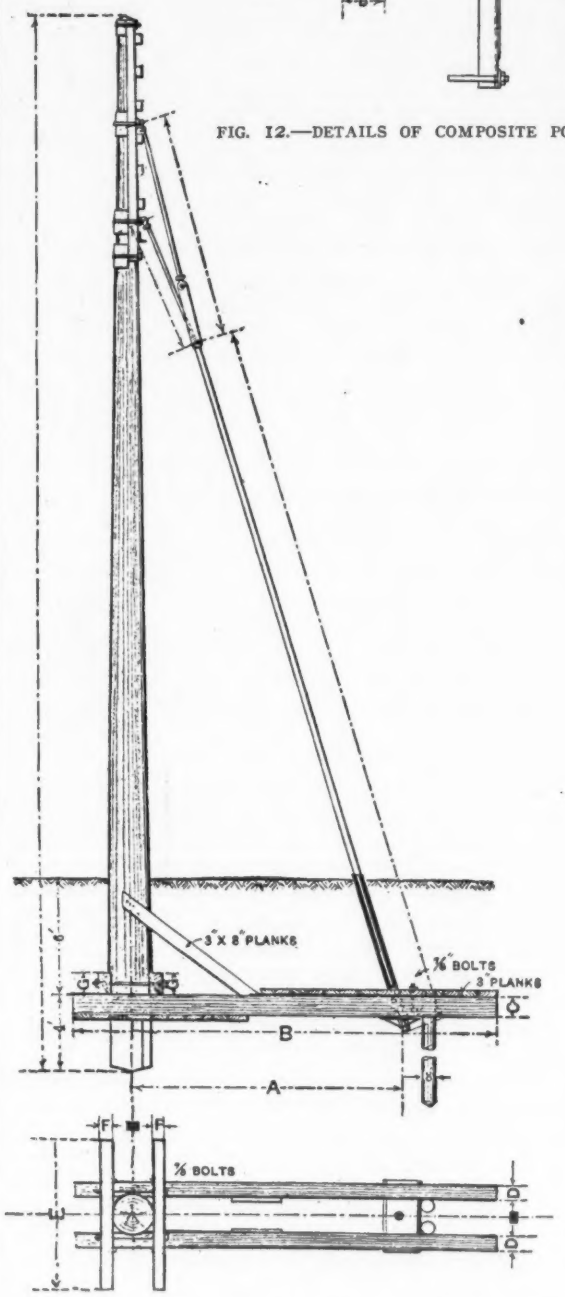


FIG. 11.—ELEVATION AND PLAN OF COMPOSITE ANCHOR POLE.

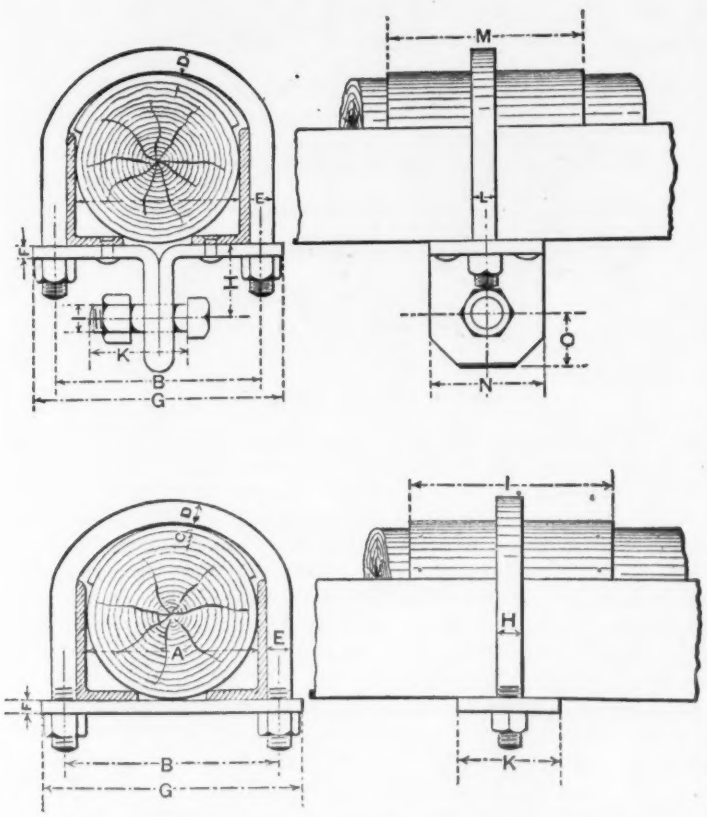


FIG. 13.—CROSS SECTIONS AND SIDE ELEVATIONS OF BANDS

DETAILS OF COMPOSITE TELEPHONE POLE CONSTRUCTION.

detail drawing of each piece; Table 8 the dimensions of the main rod; Table 9 the sizes of the branches and Table 10 data for extension plates. Poles of this description can be built at a cost of

TABLE 10.
GUY ROD EXTENSION PLATES.

No. of Cross-Arms.	No. of Cables.	A	B	C	D	E	F	G
8	0	¾	3¼	7	54	2½	3	1½
10	0	¾	3¼	7	54	2½	3	1½
6	1	¾	3¼	7	48	2½	3	1½
8	1	¾	3¼	7	54	2½	3	1½
10	1	¾	3¼	7	54	2½	3	1½
4	2	¾	3¼	7	48	2½	3	1½
6	2	¾	3¼	7	48	2½	3	1½
8	2	¾	3¼	7	54	2½	3	1½
10	2	¾	3¾	7 13/16	54	3	4	1¾
4	3	¾	3¼	7	48	2½	3	1½
6	3	¾	3¼	7	48	2½	3	1½
8	3	¾	3¾	7 13/16	54	3	4	1¾
10	3	¾	4¼	9½	54	3½	5	2¼

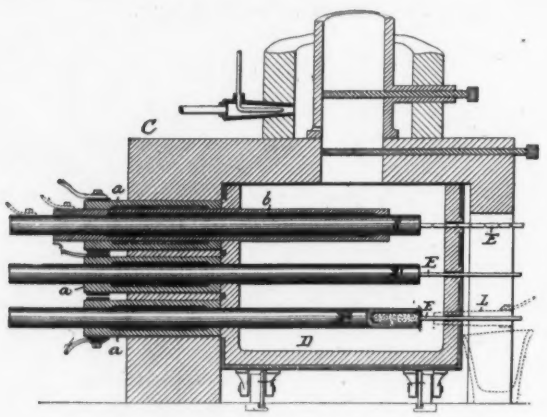
from $100 to $150, depending on line capacity. Their strength seems ample, for the author has known several blocks of a hundred-wire line with five cables to go down, leaving an anchor pole of this description the solitary sentinel at the end of the line.

Carbide Furnace.

By Clinton Paul Townsend.

The revoluble calcium carbide furnace of Mr. Hudson Maxim has been described in these columns. This early furnace might be considered, for practical purposes, as a centrifugal machine wherein a bed of fluid carbide is held against the periphery of a refractory revolving casing, and by the passage of an electric current through it, is sufficiently heated to convert superposed portions of the charge. This furnace bears the impress of its early date, when calcium carbide was regarded as a readily liquifiable compound, to be tapped from the furnace or handled therein like molten iron.

A patent recently issued to the same inventor deals with the true calcium carbide—a body which exists as a mobile mass only at temperatures which involve both a vast expenditure of heat and a vast



MAXIM ELECTRIC FURNACE.

waste. The carbide is no longer to be tapped or run from the open mouth of a drum, but is obtained as slabs or ingots embedded in the unconverted charge and permitted to cool in place in the crucible in which it is formed. The present furnace is rather analogous in its operation to the constructions of Roberts and Hewes. The electrodes are horizontal, parallel and embedded in the charge, and the circuit is closed across their ends for initiating the reaction by means of a resistance plate, conveniently formed of the carbide from a previous operation. This temporary connection is soon dissipated or fused, and the circuit is thereafter closed through the newly-formed carbide, which by the gradual and equal retraction of the electrodes is built up into a plate-like mass.

The construction will be clear from the figure. A crucible, *D*, provided with a refractory lining, is perforated at one side to permit the introduction of several superposed pairs of electrodes, *A*, *A'*, *A²*, and slotted on the opposite side for the introduction of the temporary short-circuiting plates of carbide, *E*. The electrodes may be hollow, and finely-divided carbon may be fed through them for the better protection of their working ends. The several electrodes are slidably arranged in the wall of a surrounding masonry furnace, *C*, and are preferably arranged to slide within a sleeve, *a*, inset as shown and provided with a filling of divided carbon to insure good electrical contact. In some cases a longer intermediate sleeve, *b*, as shown, fitted to the upper electrodes, is used to provide additional support for the projecting carbons. A suitable device, of ordinary form, is shown for charging the crucibles as they are brought into operative relation with the electrodes, and means are also shown for preliminarily heating the charge before introduction into the crucible. In operation the circuit is temporarily closed between the two electrodes constituting each horizontal pair, and the electrodes are then slowly retracted in such manner as to build up a plate of carbide extending horizontally across the crucible. At the end of the operation the electrodes are withdrawn entirely from the crucible and the latter is moved forward upon the tracks, another of similar construction taking its place. The furnace is thus essentially intermittent in type.

Municipal Ownership Convention.

Under the auspices of the New York Reform Club a national convention will be held in this city on municipal ownership and public franchises, February 25, 26 and 27. The following programme has been prepared by the advisory board:

Wednesday, February 25 (morning session, 10 A. M., at No. 233 Fifth Avenue).—Address of welcome by Mayor Low, of New York, and Mr. John G. Agar, chairman; "Recent History of Municipal Ownership in the United States," brief contributions by Wm. Wirt Howe, former president American Bar Association, New Orleans, La., Clinton Rogers Woodruff, of Philadelphia, secretary of the National Municipal League, L. N. Case, manager of water and light plants, Duluth, members of the staff of the New York School of Commerce, and by others; "Recent British Experience of Municipal Ownership," Mr. Robert Donald, editor of the *Municipal Journal*, London; "Recent German Experience of Municipal Ownership," Mr. Ed. T. Heyn, of Berlin; "Comparison of European and American Methods and Results," Hon. Robert P. Porter, director of the Eleventh Census of the United States; discussion. Afternoon Session, 2.30 P. M.—"Transportation," paper by Charles T. Yerkes, of London and New York, address by Mayor Harrison, of Chicago; discussion; "City Owning and Leasing," Mr. Edward M. Shepard, counsel to the Rapid Transit Commission, New York; "Massachusetts' Experience," Mr. Louis D. Brandeis, of Boston; discussion. Thursday, February 26 (morning session, 10 A. M.).—"Gas and Electric Lighting" (I, Electric Lighting), Lieutenant Cahoon, secretary and ex-president of the National Electric Light Association; discussion; II, Gas Lighting, Walton Clark, general superintendent Gas Improvement Company, Philadelphia, Pa., past president American Gas Lighting Association, Alton D. Adams, engineer, Boston, Mass.; discussion opened by Prof. Ed. W. Bemis, water commissioner, Cleveland, Ohio. Afternoon Session, 2.30 P. M.—Water and Telephones, "European Experience of Public Ownership of Telephones," Mr. Bennett, engineer for Glasgow and other British municipal telephone systems; "Argument for Public Ownership of Telephones," Prof. Parsons, of the Boston Law School; "The Superiority of Corporation Ownership of Telephones," Mr. U. N. Bethell, general superintendent New York Telephone Company; discussion; "City Ownership of Water Supply," Mr. Wm. R. Hill, president of the American Water Works Association; discussion. Friday, February 27 (morning session, 10 A. M.).—"How Should Public Service Corporations be Controlled?" Mr. R. R. Bowker, formerly of the Edison Electric Illuminating Company, New York; discussion; "Regulation and Taxation of Public Service Corporations," Mr. Allen Ripley Foote, editor of *Public Policy;* discussion opened by Prof. John R. Commons, secretary Taxation Committee National Civic Federation. Afternoon Session, 2.30 P. M.—"Labor Clauses in Franchise Grants and the Labor View of Municipal Ownership," ex-Mayor Chase, of Haverhill, Mass.; discussion; "Taxation of Franchise Values," Mr. Frederick Howe, of Cleveland; discussion opened by Mr. Wheeler H. Peckham, president of City Club, New York.

Developments in the Indiana Telephone Field.

The developments in Indiana during the past year are in some respects without a parallel in the history of telephony in that State. The investment of capital in constructing new lines and establishing modern exchanges, improving and extending old systems surpassed all previous figures. The formation of new companies and the opening up of new fields continued actively during the entire year, while indications for still greater possibilities in the near future are apparent on every hand. In Delaware and Madison Counties, the gas belt district of Indiana, exchanges were built by the Delaware & Madison Counties Telephone Company in Anderson, Muncie, Elwood and Alexandria, with toll lines connecting these exchanges together with all the smaller towns and villages in the gas belt, giving the citizens of this industrial section of the State a complete up-to-date telephone service. This system is connected with the new long-distance lines of Indianapolis, giving them a complete long-distance service over the entire State of Indiana. The increasing business of this company has gone far beyond the expectations of the management. Preparations are now being made for extensions together with additional facilities to carry on both the local and long-distance business. There has also been an independent plant built at Logansport and South Bend, which gives an independent telephone exchange in every city and town of any consequence in the State.

A great many extensions have been added to the system of the National Telephone & Telegraph Company, of Fort Wayne, which controls the long-distance work of northern Indiana. The managers report that there is considerable work to be done in the independent field during the coming year in the way of developing the farmers' trade. Already estimates are being made and purchases will soon be effected in order to start this work as early as possible. The demand for farm telephones is so great in this section of the State that the various telephone companies will be kept busy in that direction during most of the present year.

In Blackford and adjoining counties, which is covered by the United Telephone Company, there has been considerable growth. The toll business has increased 25 per cent. on the lines of the United Telephone Company and the number of telephones has increased a little over 20 per cent. All new apparatus that is being put in is of the very latest and best, so that the service is improved, as well as increased in volume. Entirely new central energy boards were put in at Huntington and Marion, both exchanges are equipped with entirely new telephones, as well as all the rest of the apparatus. A new board was put in at Montpelier and considerable extensions were made at Hartford City. The farmers of this district are now beginning to call for telephones and where they are treated fairly they prefer to connect direct with the exchanges and pay the extra price, $1.50 per month, rather than try to build their own lines. There is, therefore, no friction and the service is first class.

The Cumberland Telephone Company operates in thirteen counties in southern Indiana, and has in operation at this time more than 10,000 telephones. It is perhaps the only company that has anything that approaches a comprehensive long-distance telephone system. The central exchange for this system is in the city of Evansville and the situation there is extremely interesting and perilous. The city authorities have declared that the Cumberland Company's franchise has expired by limitation, and have brought suit to oust it from the streets of the city. The company's defense is that it has a perpetual charter and is confident the court will sustain its right to continue business in Evansville. In either event there is great prospect for improvements and extensions in this field. If the city wins it will install a new municipal telephone plant, and it is so sanguine of its position that steps in that direction are already being taken. The New Telephone Company and the New Long-Distance Telephone Company, of Indianapolis, covers central Indiana thoroughly and has made many improvements and long-distance extensions during the year. These improvements, however, are to be followed by still greater during the present year. This company has looked carefully to its relation to the financial world evidenced by its reports made to the stockholders.

As great as the telephone business of Indiana now is, there still remain a few unoccupied fields and the possibilities in construction and the improvement and extension of plants already in operation, will call for vast expenditures of money for labor and material during the present year.

New Telephone Patents.

A few weeks since brief mention was made under this heading of a patent covering an arrangement of telephone circuits wherein by the use of more than one induction coil at the subscriber's station, increased efficiency of transmission was claimed. In a patent issued February 3, 1903, entitled, "Telephonic apparatus," and granted to the same inventor, C. G. Burke, of Brooklyn, N. Y., another device of the same nature is described. In this latest circuit, shown in Fig. 1, wherein the right-hand end of the line only is provided with the modified apparatus, there is inserted in the main line the many-turn, high-resistance secondaries of several induction coils, the primary windings of which, of less turns and less resistance, are connected together and to an auxiliary receiver to be used to supplement the usual receiver, M^1. In his specification Mr. Burke states that by such a combination the speech transmitted is much improved, both in volume and clearness, and that the improvement increases with each additional auxiliary induction coil. He also states that to obtain the best results the auxiliary coils should not be duplicates, but should have different ratios of conversion and different resistances.

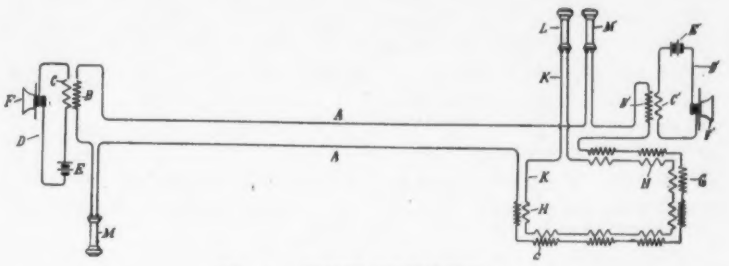


FIG. 1.—BURKE TELEPHONE.

A careful consideration of the circuit fails to reveal any reason for any real gain in efficiency, and the inventor himself is evidently at a loss to explain it, for he says in regard to it, "I do not advance any theory in explanation of this fact." It is, however, quite easy to see how with the arrangements of circuit shown an apparent gain is obtained, for each additional induction coil adds to the proportion of the energy available for the auxiliary receiver and subtracts from that available in the low-resistance line receiver. The net total energy, of course, must be reduced by the additional iron losses, which prohibit any real gain.

A patent issued the same date to Charles H. Gaunt, of St. Paul, relates to combined telegraphy and telephony on that system where each metallic circuit is available for the simultaneous transmission of one message of each kind. Fig. 2 shows the rudimentary circuit wherein 2 2 is a telephone line having the bridged stations, *A A*, and the telegraph stations, *C C C*. As is seen, taps are carried at the telegraph stations, one from each side of the line, through the non-inductive resistance coils, 11, 11; through the inductively equal coils, 3 to the point *E*, and thence through the telegraph instruments. The novelty in the invention lies in the mutual relations of the coils, 11, 11 and 3. These latter, the inductance coils, are wound to the same number of turns each, and are so connected as to form an inductive circuit for the telegraph currents and a non-inductive path for the telephone currents. In order not to shunt an appreciable portion of the telephone currents, these coils, 3, are wound to a high resistance, as are also the coils, 11, 11, which are not made exactly equal, but are adjusted to compensate for any inequality of resist-

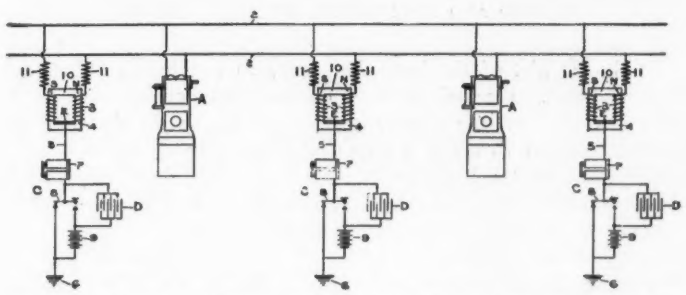


FIG. 2.—GAUNT COMBINED TELEGRAPH AND TELEPHONE SYSTEM.

ance in coils, 3. All this results in a reduction of disturbance to the telephone system from the telegraph signals, first, by dividing the telegraph currents exactly equally between the two sides of the line, and second, by prohibiting any abrupt changes of potential on account of the choking effect of the inductance coils.

The third telephone patent of this issue provides a new message-counting, or service-meter system, the inventors being Messrs. A. M. Bullard and L. A. Falk, who have assigned the patent to the American Telephone & Telegraph Company. This system provides a message counter, adaptable to party line service, to be located at the several stations and yet under control of the central office operator.

In Fig. 3 is shown a connection completed through a central energy central office of the Bell type, involving a single-station line and a two-station line. At each station at *H* is shown the counting mechanism, controlled by a polarized electromagnet, *v*, and wired in the branch line circuit of the station. At *u* is shown a non-inductive shunt circuit, so proportioned that while the meter-operating current will properly affect the counter, the alternating ringing current will not affect it. At the same time it provides a path around the inductive meter coil of inappreciable effect in reducing the transmission. At the central station there is provided the direct-current generator, S^2, which runs at a constant potential much higher than that of the battery, *S*, and which has one pole, the reverse from that of the battery, grounded. When this generator is connected to a subscriber's line having the receiver off the hook, a current much greater than the normal and in the reverse direction flows, with the result that the properly poled meter operates to count one message.

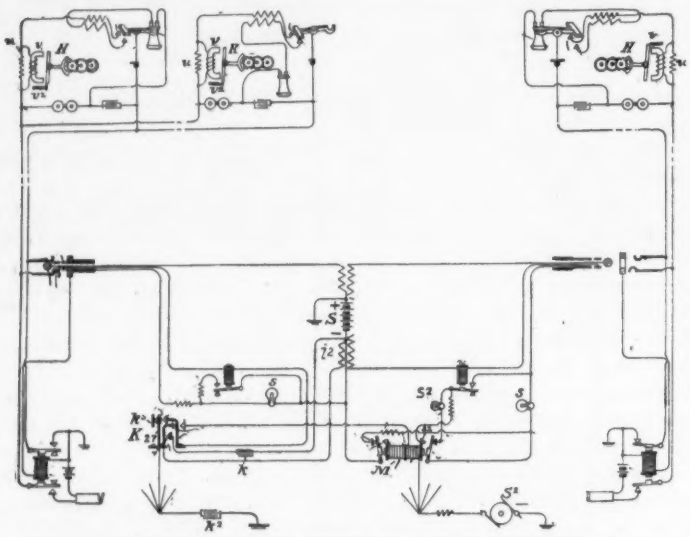


FIG. 3.—BULLARD AND FALK TELEPHONE METER AND APPARATUS.

This is the gist of the invention, but two interesting refinements are introduced. One of these is the especial arrangement of the meter key, *K*, and the condensers, *k* and k^2, by which, when the key is depressed to make a count, the line circuit which is to be transferred from the battery to the generator is connected to ground through the condenser, k^2, while the repeating coil winding, i^2, whose circuit is to be opened, is shunted by the condenser, *k;* with the result that all coil discharges find a path through the condensers, relieving the subscribers' telephones of part of the disagreeable resulting rush of current. The second refinement is the provision of the switching relay, *M*, and the signal lamp, S^2, so related that the operator is given a signal to register the call by the answering of the called party.

Both of the remaining telephone patents are granted to James A. Wotton and assigned by him to the Wotton Electric & Manufacturing Company. The first of these describes a new transmitter, while the second is for a method of manufacturing electric condensers. The novelty of the transmitter lies in the insulating of what may be termed the back electrode, from the case or carbon chamber, and the supporting of the movable electrode upon a metallic diaphragm. Thus in a transmitter of the general type of the Bell solid back, the mica disc is replaced by a metallic annular disc serving as a flexible and conducting connection between the frame and movable electrode, while the stationary electrode is mounted upon rigid insulating material. This would seem to be an admirable idea and result in an efficient instrument.

The improvement in the manufacture of condensers lies in the use of ordinary, unimpregnated paper during the building up of the condensers and the simultaneous removal of the moisture from, and the impregnation of the paper with, suitable filling insulator, by treating the built up condensers in a heated bath of wax. By this means the cost of manufacture of the condenser is said to be much reduced.

The Engineering of Illumination.

Mr. V. R. Lansingh addressed the Western Society of Engineers in Chicago on February 4, 1903, on the subject, "The Engineering of Illumination." Mr. Lansingh is a specialist in illuminating engineering in Chicago.

He introduced his remarks by calling attention to the fact that a great deal of thought has been given by engineers in times past to securing the highest efficiency from power house apparatus, and the lowest losses in the distribution of electric current and in transforming it into light. When, however, it comes to using the light supplied by this current, there is great wastefulness. It is safe to say that 25 per cent. of the electric light in this country used is unnecessarily wasted. There is evidently more chance to secure greater efficiency by studying the engineering of illumination than anywhere else in connection with electric light work.

Mr. Lansingh then went into a discussion of interior illumination. The first requisite of good illumination, he considered to be steadiness, particularly in inside lights, and one casting shadows involves constant labor on the part of the eye to adapt itself to changing conditions, and is entirely unsuited to interior lighting. Next in importance he placed diffusion of light, so that the illumination is even throughout the space to be illuminated. In this connection the relative intensities of the flames of various illuminants were given. The third requisite is that the light must be out of the direct line of vision. The influence of the color of walls on interior illumination was discussed, it being shown that white walls reflected about 80 per cent. of the light, while black absorbs about that much. Mathematical formulæ were given for obtaining the illumination at various distances from the source of light. Shades and reflectors were discussed briefly, and the undesirable effects of mirror reflectors without some form of diffusion were shown.

Independent Telephony in Kansas

About 100 managers of independent telephone exchanges in Kansas met in Topeka on January 28, 29 and 30. A contract was made with the Kansas City Independent Telephone Company to connect Kansas City and Topeka by an independent system within four months; Topeka and Wichita and Topeka and Belleville within six months.

Among the papers read on the 29th were: "The Engineering of the Kansas City Exchange," by M. C. Polk; "Progress in Southeastern Kansas," by M. L. Robeson, of Galena; "Hic Jacet Berliner," by Charles E. Wells, of Marion, and "Our Needs as I See Them," by W. H. Nelson, of Smith Center.

New officers of the association for the coming year were elected as follows: A. A. Godard, of Topeka, president; J. M. Doyle, Belleville, vice-president; Charles V. Wells, Marion, secretary, and J. W. Smith, Minneapolis, treasurer. The new Executive Committee is composed of C. H. Munsell, Hiawatha; J. E. Byers, Ottawa; W. H. Nelson, Smith Center, and A. R. Champlin, Newton.

The Cuyahoga Telephone Company.

The report of President Dickson, read at the annual meeting of the Cuyahoga Telephone (independent) Company, of Cleveland, Ohio, which was held on February 4, shows a very satisfactory condition of the company's affairs. The report for 1901 showed a deficit of $29,684, while that for 1902 shows a surplus of $542. Mr. Dickson calls attention to the fact that it cost the company $10,000 a year to collect the rentals, whereas the work is done by other companies of corresponding size for $6,000. He will inaugurate economies in this direction, and will reduce the number of employees. The expenses of management, he says, have been far

too high in the past, and he promises to effect a saving by discontinuing useless departments and consolidating others. Extravagance in the previous management of the company's affairs was the keynote of his report. The officers elected are: F. S. Dickson, president; E. W. Moore, vice-president, and J. B. Hoge, secretary.

President Dickson proposes to raise $400,000 necessary to make required improvements and betterments by offering $2,000,000 worth of 6 per cent. cumulative preferred stock to stockholders at 60. The plan provides for the liquidation of the Federal Telephone Company's claims against the Cuyahoga Company, by the acceptance by the former of 7,415 shares of the new stock.

CURRENT NEWS AND NOTES.

CHINESE TELEGRAPHS.—In spite of its recent assertion that it had abandoned the proposed scheme, the Government of China has again announced that it has decided to assume control of the Commercial telegraph line and the local Taotai at Shanghai has formally requested the consuls to forbid foreigners to purchase shares in these lines.

ST. LOUIS WORLD'S FAIR DEDICATION.—The grounds and buildings of the St. Louis World's Fair will be dedicated on April 30 next by President Roosevelt and an address will be delivered by ex-President Cleveland. A military pageant will precede the dedication ceremonies, which will take place in the Palace of Liberal Arts. Arrangements are being made for the seating of 60,000 people within the building, which is 720 feet long by 525 feet wide. A grand display of fireworks will take place in the evening.

OHIO ENGINEERS.—The Ohio Society of Mechanical, Electrical and Steam Engineers will hold its next meeting in Warren on February 14. Several papers of interest to those engaged in these branches of engineering will be presented. Among them are the following: "Oiling Systems for Power Plants," by P. E. Moock, of Canton, and "Gas Engines *vs.* Steam Engines," by E. M. Adams, of Akron. The officers of the association are E. E. Miller, Canton, president; C. J. Miller, Canton, secretary, and R. H. Probert, Akron, treasurer.

AUTOMOBILE MAKERS MEET.—Officers for the coming year were elected by the National Association of Automobile Manufacturers at a meeting of the Board of Directors, held in New York City last week, as follows: President—M. J. Budlong, Hartford, Conn.; First Vice-President—H. W. Leonard, Bronxville, New York; Second Vice-President—W. T. White, Cleveland, Ohio; Third Vice-President—Charles Clifton, Buffalo, N. Y.; Secretary—H. T. Unwin, New York City; Treasurer—Percy Owen, New York City. The association is directing its efforts at present toward making a success of the National Good Roads Convention to be held at the Auditorium, Chicago, on February 14.

LECTURE ON SUBMARINE CABLES.—Dr. A. E. Kennelly, of Harvard University, is to lecture before the New York Electrical Society on Wednesday, February 18, at 8 P. M., at the American Institute, 19 West Forty-fourth Street. The lecture, which will be illustrated profusely with lantern slides, and to which ladies are specially invited, will deal with the Doctor's own experiences in laying recently an all-American cable across the Gulf of Mexico, and will thus combine the personal element with a great deal of useful and up-to-date information. Dr. Kennelly has in a marked degree the gift of popular exposition, and the lecture will be one of the events of the society's very successful season.

MARCONI WIRELESS TELEGRAPH NEWS AGENCY.—A cable dispatch from London of February 7 says: The Chancery Court to-day granted the Marconi Wireless Telegraph Company an extension of its powers by which it is entitled to carry on the business of news agent and publisher on shipboard. This probably refers to the scheme of publishing a daily newspaper on shipboard, the news being received by wireless telegrams. Mr. Marconi, who was a passenger on the *Etruria*, said the idea of publishing a daily newspaper with wireless dispatches had taken tangible form. When the *Etruria* was twenty miles west of Browhead a summary of the day's news was transmitted, printed and distributed to the passengers.

THE ENGINEERS' CLUB.—The Engineers' Club has acquired the property, 32 and 34 West Fortieth Street, New York City, a plot 50 x 98.9, facing Bryant Park and the new Public Library site, and now occupied by two five-story English basement houses. The seller of the property is William M. Martin. It is the intention of the Engineers' Club to erect a new clubhouse on this site, although it is not likely any active steps in the matter will be taken for some time to come, as the club's lease on its present quarters at 374 Fifth Avenue has four years yet to run. The Engineers' Club is the second organization to select this block on Fortieth Street as the location for a new house. A little further to the west, nearer to Sixth Avenue, stands the new twelve-story structure of the Republican Club, only recently completed. The great New York Library will occupy the center of the block, facing on Fifth Avenue.

CHICAGO MUNICIPAL OWNERSHIP.—Cheaper light and heat for the people of Chicago will be the argument on which the civic committee will urge the legislature to pass the Finn bills, providing for public ownership of gas and electric light plants, adopted by the City Council. Chairman Finn of the committee says: "Not only would the people of Chicago get cheaper light under municipal ownership, but heat could be furnished to every home at such a price as would make another coal famine an impossibility. Were the electric light bill passed the city should at once proceed to put it into operation, and as a first step should secure from the sanitary district the right to the invaluable water power at Lockport. With this cheap power not only could we light all our streets with electricity at comparatively small cost, but we could furnish electric light to the people much cheaper than rates which now rule for gas." In fact, we don't see why anything need cost anybody a cent.

MARCONI SYSTEM IN CANADA.—Some opposition has been offered to the establishment of a Marconi station at McGill University, Montreal, Canada, on the ground that such a station would seriously impair the usefulness of the physical labaratories, but more important still, the operation of a wireless telegraph station in Montreal or its vicinity would increase the danger of fires arising from defective insulation of electric wires of all kinds throughout the city, and might, therefore, increase to the university, in common with all the citizens of Montreal, the cost of insurance against fires. Willard D. Green, general representative of Mr. Marconi in Canada, denies that the establishment of a wireless telegraph station on Mount Royal, 700 yards away, will affect the instruments in the McGill laboratory. He also denies that there will be any danger from fires in case of defective insulation or that the transmission of a message will cause great noise. He intimates that some of the governors of McGill are very much interested in telegraph and cable companies, and that this may account for their opposition. Sir William Van Horne, R. B. Angus, Lord Strathcona, James Ross, and other large telegraph shareholders are also governors of McGill.

WIRELESS STOCK QUOTATIONS.—Last week quotations of the curb stocks were sent in New York City by wireless telegraph to the office of Dow, Jones & Co., at 44 Broad Street. An automobile with a De Forest wireless apparatus on board sent the messages up a seven-foot brass pole into the air. The "responder" was put up in one of the inside private offices of Dow, Jones & Co. in the basement of the Edison Building and the door was closed. A ground connection was made by connecting the little machine with a water pipe. The sending operator sat on the side of the automobile and clicked away on an ordinary telegraph key. The curb reporter hands the quotations to the operator on the wagon instead of to messenger boys, thus saving three or four minutes on each quotation. Stocks sometimes go up three points in a minute on the curb and reporting them has been slow compared with the exchange quotations. President White, of the De Forest Wireless Telegraph Company, said that Henry Clews & Co., Miller & Co. and several other firms were going to try the experiment of having receivers in their offices in Broad Street, where the curb market is. There was no doubt, he said, that messages could be sent to Broadway offices, too. The company has had four automobiles constructed with the sending apparatus and poles for this purpose and propose eventually, so its promoters say, to supply a news service.

WIRELESS TELEGRAPH STATIONS FOR YACHTS will, it is stated, be established at Newport and on the north shore of Long Island, so that yachts on the Sound, which they frequent so numerously all summer, can be constantly in touch with the land, for all manner of purposes.

"ONE-A-PENNY."—In England, the Sunderland Town Council has decided to try the experiment of supplying electricity for the lighting of the workmen's dwellings owned by the municipality on the penny-in-the-slot principle. The corporation propose to supply an 8-cp light which will last five and one-fifth hours for one penny.

TRAIN WIRELESS TELEGRAPHY.—A cable dispatch from Berlin of January 29 says: The experiments on the military railroad between Berlin and Zossen in connection with keeping a moving train in continuous wireless communication with the signal station have been completely successful. The Braun system was used.

CHEAP RADIUM.—A cable dispatch from London of February 7 says: In connection with the articles on radium and the price of that extraordinary metal, a correspondent writes to one of the newspapers: "I am selling pure radium bromide at 8 shillings per milligram, which is equal to £400,000 per kilo." This is about $900,000 per pound. Scientists are the only purchasers.

CONNECTICUT THIRD RAIL.—At Hartford, on February 5, in the State House of Representatives Senator Ney presented a bill for the incorporation of a trust company in Hartford by attorneys for the projected third-rail railroad between Hartford, Middletown, and New Haven, the capital stock to be within $10,000,000. The trust company, it is understood, is for the purpose of financing a projected parallel to the New Haven Road.

TRANSPORTATION IN LONDON.—A royal commission has been appointed to inquire into the question of the locomotion and transport needs of London and the desirability of establishing some authority or tribunal to which all schemes of railway and street car line construction should be referred. Sir David Barfour is appointed Chairman of the commission, which includes among its members Earl Cawdor, Sir John Wolfe-Barry, and a dozen other prominent men.

RAILROAD TROLLEY FEEDERS.—A most interesting article appears in the valuable periodical, the *World's Work*, for February, by Sylvester Baxter, on the manner in which the Boston & Maine Railroad, under the far-sighted policy of President Tuttle, has built up a fine subsidiary trolley system as a feeder and parallel to its main steam lines, not only supplementing them, but creating new traffic under new conditions. Mr. Baxter points out how in many ways the traffic differentiates from that of the old steam system.

DIGEST OF AUTOMOBILE AND HORSELESS CARRIAGE PATENTS.—The American Patents Publishing Company, Washington, has issued a supplement from June, 1899, to January, 1902, to the "Digest of United States Patents of Automobiles and Horseless Carriages," since which latter date digests of these patents have been published in the *American Electric and Automobile Patents Monthly*. One of the important features of the Supplement is a list of all references cited against each application in its course through the Patent Office.

AMERICAN INVENTION IN 1902.—The report of the Commissioner of Patents for the calendar year 1902 shows a total of 49,490 applications for patents, including designs, and that 27,776 patents, including designs, were issued. In addition there were 110 patents reissued, 2,006 trade marks registered, and 767 labels and 158 prints registered. During the year 23,331 patents expired, 4,471 applications allowed were forfeited because of non-payment of fees, and 9,284 allowed applications are still awaiting final fees. The excess of receipts over expenditures was $159,514.

BIRKELAND ELECTROMAGNETIC GUN.—A cable dispatch from Berlin of January 31 says: Birkeland's electromagnetic cannon, the one described in the technical press a year ago, is now engaging the attention of German artillerists, in an improved shape. Although it is only available in forts and is too complex to be trusted to an ordinary gunner, the German experts regard it as the forerunner of a new type of ordnance. The principle of the gun is the passing of a powerful current through wire spirals in the bore without heating. It throws a fifty-pound projectile more than three miles with accuracy. But Birkeland says he can increase the distance four-fold. This is the first electric gun the German artillerists have found practicable. The above, we surmise, originated with the press agent of the gun.

MARCONI SYSTEM ABROAD.—A commission appointed by the Italian Government to consider the establishing of wireless communication between Italy and the Argentine Republic has made a favorable report on the subject. It is understood that the government will allot $140,000 to equip the Italian station, which will also serve subsequently as a means of communication with Erythrea and Sardinia. The Marconi system has also been adopted to complete telegraph communication between Cape Town and Cairo. Telegraph wires are already erected from Cape Town to Ujiji, a distance of more than 3,000 miles. It is expected that wires will soon be finished from Cairo to Fashoda. Owing to the country between Fashoda and Ujiji presenting serious engineering difficulties the wire lines will be linked by the etheric system, at least temporarily.

GERMAN ELECTRICAL CONSOLIDATION.—Referring to reports already published in these pages, a cable dispatch from Berlin of February 10 says: The Siemens-Halske and Schuckert Electrical Companies have decided to unite, subject to the approval of the stockholders. An impulse towards amalgamation was given by the Allgemeine and Union combination on December 22. The Siemens-Halske Company has a capital of $13,625,000, and $7,500,000 in debentures. The Schuckert Company, which lately was in financial difficulties, has a capital of $10,500,000 plus $7,000,000 of the Continental Financing Company. The new concern is to be a limited company with a capital of $25,500,000. It will be known as the Siemens-Schuckert Works. It is understood that the old companies share about equally in supplying the capital. All the "watered" stock and worthless assets will be eliminated and only the factories, material on hand, and sound accounts will figure on the new books. All the shares of sub-companies will be excluded, as well as those of the Siemens Dynamo Works at Charlottenburg and the cable works at West End. The combination will take over the old companies in April. All the electrical works of Germany are now practically included in the two companies, and it is believed that the latter will make common prices.

LETTER TO THE EDITORS.

Stresses in Alternator Frames.

To the Editors of Electrical World and Engineer:

SIRS:—Referring to the article in your issue of January 24 on "Stress on Frames of Alternating-current Generators," I wish to call your attention to the fact that the author has neglected torque in the inner circumference of the core, which tends to move the point of greatest stress from the center in the direction of rotation, and which certainly enters as an important factor in regard to stress. The force due to this torque in the example given would be about 10,000 lbs. at 500 kw and 100 r.p.m., which is about the same as the total weight of the stationary part.

But I think it unnecessary to develop the formula, as this method of calculating is of no consequence whatever. The frames of great machines must be calculated in relation to the airspace, that is, the deflection must be calculated just as in the case of a shaft, and the frame dimensioned accordingly. I think it unnecessary to give any formula relative to this case, as there is an excellent article, "The elastic curve of three-phase machines with great diameters," by Hans Linsenmann, in the *Elektrotechnische Zeitschrift*, Nos. 5 and 6, 1902.

At the same time I wish to congratulate you for taking up this matter in your paper, as it should stir up American designers and prevent the present enormous waste of material in alternating-current generator frames. The European manufacturers are in this case very much ahead of the American, possible on account

of the serious economical crisis in the electrical industry and the high prices of material. They have tried, as is well known to designers of electrical machines, to avoid absolutely the use of cast iron for the strained parts. In this particular construction, the "strutted" frames of the A. E. G. and the wrought iron frames of the Siemens & Halske firms are typical examples. Where cast iron is used, they have tried to diminish weight by the use of strain bolts and the application of special supports in the foundation for the lower half of the frame.

The saving of weight is enormous and in a 5,000-kw frame, where the magnetic iron has a weight of 40 tons, the total weight of a strutted frame is 50 tons, as compared with 235 tons of an American cast-iron frame of the ordinary construction.

WILKENSBURG, PA. A. HANSSON.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Heyland Motor.—HEYLAND.—The first part of a detailed illustrated description of the latest form of construction of his non-synchronous machines with compensation and compounding. Different firms have taken up this type and have reached the same construction. He first discusses the choice of the dimensions of these machines and then deals with the theory of commutation in the exciting commutator. This theory is essentially different from that of the commutation in direct-current machines, and a new winding (polyphase winding with branches connected in parallel) has been developed which is now used in all larger machines. This form of winding avoids entirely all disadvantages which were still found in the earlier forms of this machine. In discussing the choice of the dimensions of the rotor, he gives a comparison between non-synchronous machines and synchronous machines, and shows that the difference between his excited non-synchronous machine and the ordinary non-synchronous machine is the same as between a normally excited synchronous machine and a synchronous machine without excitation; the excited non-synchronous machine is superior to the synchronous machine in all points in which the ordinary unexcited non-synchronous machine differs from a synchronous machine without excitation. He says that these points have been of great advantage, as they enable him to build broader machines with smaller diameter and of more compact form than the ordinary machine, and to use a simple form of slot with a few large open slots per pole. He then discusses the dimensions of the commutator and states that in his machines the commutator surface per kilowatt is only about 5 to 10 per cent. of that in direct-current machines of the same capacity; he shows that this is due to the use of a short-circuited armature. The number of brushes is given by the number of phases; for a compensated three-phase machine three brushes are required, and if the machine is compounded, three more brushes for the compounding current, i. e., in the whole six brushes. The minimum number of segments per pair of poles is, therefore, 6 segments for the compensated machines and 12 for the compensated and compound machines; i. e., 3 or 6 segments per pole. These numbers of segments are used in small machines, while in large machines the maximum number of segments used per pole is 12. The most important part of the machine is the winding of the rotor; it has to fulfill a double purpose; it must be a short-circuited winding, and it must at the same time permit the supply of the magnetizing currents to the rotor by means of a commutator. This problem has been solved in a perfect manner in the latest type of winding. The author begins with a general discussion of the theoretical principles of the commutation in his machine. The paper is to be continued.—*Elek. Zeit.*, January 22.

REFERENCE.

Action of Shunt-Wound Motor when Driven by a Series-Wound Dynamo.—MCALLISTER.—An illustrated article in which the author analyzes the phenomena connected with the operation of shunt-wound motors driven from series-wound generators.—*Am. Elec.*, February.

LIGHTS AND LIGHTING.

Electric Train Lighting.—DOWLING.—An abstract of a paper read before the Dublin Section of the (Brit.) Inst. Elec. Eng. The author briefly describes some of the most important systems of electric lighting in use in America, Continental Europe and England, and then gives a detailed description of the Stone system. Each coach has a complete installation of dynamo and storage batteries quite independent of any other coach; the connections and regulation of the power supplied to a generator by means of a belt which slips after attaining a certain speed, are discussed. In the discussion, Tatlow suggested that the arrangements for supplying oil to the bearings of the dynamo were elaborate, and asked whether the ordinary ring method of lubrication would not answer all requirements. It was also asked whether any explosion of the gases in the containing boxes of the storage batteries had occurred. In replying, Dowling stated that the conditions are very exacting, and it is necessary to exclude dirt and grit; space is very limited and there is probably not sufficient room to admit of the adoption of the oil-ring method of lubrication. He had seen a cell explode on one occasion, when the gases were ignited by a spark.—Lond. *Elec.*, January 23.

REFERENCE.

The Electric Arc.—A didactic article on the electric arc, discussing the various causes for the differences in the color of the light emitted from the arc.—*Am. Elec.*, February.

POWER.

The Water Powers of Switzerland.—THORMANN.—An account of an investigation as to whether it is possible to obtain from waterfalls the electric power required to operate all the railroads of Switzerland. He finds that the complete substitution of electric power for steam is quite possible, but it would not entail an appreciable decrease in the actual cost of operation. The five principal railroads existing to-day in Switzerland require a daily motive power of more than 30,000 hp. To organize a general electric service, it would be necessary to have available high-tension alternating currents of an appropriate power of 60,000 hp, besides an indispensable reserve. Without taking into account the numerous waterfalls which have so far not been utilized, there are on Swiss territory 21 large stations, producing sufficient energy to furnish at present 86,000 hp. Among them are the Siel and the Lanfenburg stations, each of 20,000 hp, and those of St. Moritz, of Nangen-sur-Aar, of Bernan, and of Voeggisthal, each of 5,000 hp. These 21 stations would, of themselves, be more than sufficient to distribute the necessary power to the Swiss railways. The cost, however, of the conversion of the railways to electric traction would amount to nearly 32½ million dollars. The adoption of electric traction would have the advantage of doing away with the present consumption of coal, now imported from other countries, and the use of electric power would encourage the development of several national industries.—*L'Elec.*, noticed briefly in Lond. *Elec. Eng.*, January 16.

Electric Operation of Bridges and Canal Lifts.—A note stating that the electric operation of a bridge over the River Weaver at Northwich has been so successful that the navigation authorities have decided to work the Anderson Canal lift by electricity also. This lift is at the point where the River Weaver is connected to the Shropshire Union Canal. When this conversion to electric operation has been completed one man in the switch house will be able to control all the necessary movements, whereas heretofore eight men have been necessary to work the lifts. The electrical plant comprises two motors for working the lock gates at the end of the Shropshire Union Canal, which is 70 feet above the level of the Weaver; one motor on each of the pontoons controlling by means of ropes the lock gates at either end, and one motor in the engine house directly connected to a variable-stroke pump to supply

water under pressure of 700 pounds per square inch to the same. The two vertical cylinders of the hydraulic lifts are connected so that as one pontoon sinks it forces up the other; an additional supply of water under pressure is, however, necessary to overcome friction and any difference in weight between the two pontoons.—Lond. *Elec. Eng.*, January 16.

REFERENCES.

Care of Induction Motors in a Large Factory.—WEEKS.—A short article giving much practical advice on the starting and operation of induction motors in factories.—*Am. Elec.*, February.

Electric Control for Elevators.—JAMES.—An illustrated article describing the fundamental features of the semi-automatic push-button system, which is an elaboration of the magnet system of elevator control.—*Am. Elec.*, February.

TRACTION

Surface Contact System.—A well-illustrated description of the Cruvellier surface contact system for long-distance traction, with 3-phase currents at 3,000 volts. The adjoining diagram shows two

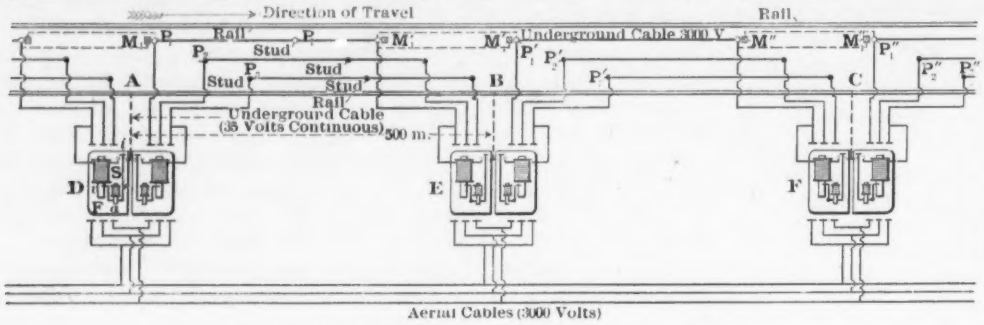


DIAGRAM OF CRUVELLIER SURFACE CONTACT SYSTEM.

sections of the road, *A B* and *B C;* they are supplied with current from the distributing boxes, *D*, *E* and *F;* these are double, each half corresponding to a distinct section; the sections are applied at both ends. The studs of the section *A B* are marked P_1, P_2 and P_3; those of the section *B C* are P'_1, P'_2. The last three studs of the section *A B* are connected with the left-hand side of *E*, and the first three with the right-hand side of *D*. All the studs on the same line, *P* for instance, are connected together by an armored underground cable laid along the road; each stud forms a junction box. At both ends of each section are placed the boxes marked *M*, connected with the preceding and the following sections; their object is to facilitate the crossing from one section to the other, without interruption of the current; the position of these boxes is determined by the train speeds. When a train is at a standstill on the section, *A B*, there will be no current on this section; as soon, however, as the driver works the controller, the first contact of the latter sends through one of the lines (that of the studs, P_1, for instance), by means of the electric sliding pieces, the current from a small storage battery, which acts upon two small electro-magnets placed in the two corresponding contact boxes; the connections at both ends of the section are thus established and the section is under current, so that the train will be able to proceed. As soon as the train has left the section the electro-magnets no longer have current, and the contacts drop by the combined action of their weight, and that of the electro-magnet cores; the section is thus cut out of circuit. The diagram shows the manner in which the connection is established between the 3,000-volt cables and the sections of studs by means of the distributing boxes. The triple contact, which makes the connection, is governed by the direct-current solenoid, *S*, the core, *F*, of which operates the triple make-and-break; the solenoid, *S*, is supplied with current from a storage battery carried on the engine or car, and connected to one of the wires and to earth. The connection with one of the line wires is by the small make-and-break, *i*, governed by a small solenoid, *e*, connected in series with one of the line wires, the core of which operates a bolt, *v;* this maintains the contacts, although the exciting of the direct-current electro-magnet be cut off. When there is no train on a section, the core, *F*, is down, the alternating contacts are open, and the core, *a*, has disengaged the bolt, which establishes the contacts at *i*. When a train runs on the section, it delivers to *S* a direct current through the make-and-break, *i;* the direct-current contacts close, the current flows through the alternating-current solenoid, *e*, the core, *a*, is drawn in, the bolt, *v*, engages the core, *F*, and the direct current is cut off at *i*. The section remains under current by the sole action of the electro-magnet, *e*, and there is no longer connection between the studs and the road, the circuit of the solenoid, *S*, being cut out. When the train runs off the section the alternating current is cut out at *e*, the bolt, *v*, disengages the core, *F*, the triple contact is broken and the section is idle. At the same time the make-and-break, *i*, will close and be ready to receive direct current from the following train. Should it be decided to establish a block, it would be sufficient to insert a small winding between the electro-magnet, *e*, and the contacts, *i*, and to connect it with the following section; no train could then proceed on the section so long as there is one on the following section. A small electro-magnet on the locomotive or car serves to cut off the connection between the storage battery and earth, so that when running there is never a pole to earth. The current is collected by a special type of sliding contact, formed of small laminations, and which, during exhaustive experiments, has withstood a strain equal to that of a total run of 6,300 miles at a speed of 112 miles an hour, there being practically no wear and tear. The length of the different sections of the road depends upon the traveling speed required; for a speed of 60 miles an hour each section would be 1,640 ft. in length; for double the speed they would be 3,280 ft. in length, and in both cases each section would remain alive for 18 seconds only. The system has insulated mains, there is no return through the rails; the pressure in the aerial feeders is 3,000 volts; the underground cables are also at a 3,000-volt pressure and supply the studs; the latter are placed about 30 ft. apart. Compared with the third-rail system, it is claimed that this system shows an economy of cost of working of about 30 per cent. in electrical energy. Nothing is said about the motors which are to be used.—Lond. *Eng'ing*, January 2.

British Tramway Statistics.—As a supplement to this issue the annual table of electric tramways and railways is published, which shows a large increase in the number of lines in operation in the United Kingdom. At the beginning of last year 85 electric tramways and railways were running; to-day there are 113, an increase of nearly 33 per cent. This, moreover, is irrespective of the number of lines which have been added to existing systems, and it is probable that the mileage of electrically-driven lines has been almost doubled. There are fewer lines "in progress" and "projected" than last year, but this points rather to the extreme rapidity with which electric tramways are now pushed through, than to any decrease in the activity in electric traction. Most of the new lines are on the overhead trolley system. A single instance of the Siemens "bow" collector is nearly completed at Sheerness, and there are a modern conduit system at Bournemouth and a surface conduit system at Wolverhampton, both of which are running satisfactorily.—Lond. *Elec.*, January 23.

Large Three-Phase Locomotive.—A note stating that Ganz & Co. have secured an order for three 3,000-volt, 3-phase locomotives for the Adriatic Railway. These will be the largest electric locomotives in Europe, being intended for a speed of 40 miles per hour, with a normal tractive effort of 8,000 pounds and a maximum tractive effort or 12,000 pounds. When drawing freight trains at 20 miles per hour, the normal tractive effort has to be 14,000 pounds and the maximum 22,000 pounds. The locomotives are of the 4-axle type and will weigh 56 tons. The motors will be connected in cascade for drawing freight trains and for starting passenger trains.—Lond. *Elec.*, January 23.

REFERENCE.

Railway Signals.—PIGG.—A long and well-illustrated paper on railway block signalling.—Lond. *Elec. Eng.*, January 2.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Electrical Equipment of a Large Department Store.—KNOX.—An illustrated article describing the mechanical plant of R. H. Macy & Co.'s department store building in New York City. The building is electrically lighted, and electricity is also used to drive motors, parcel conveyors, pneumatic blowers, carpet and sewing machines, ventilating fans, glass-cutting machines, laundry and kitchen machinery, etc. The plant, which is situated in the sub-basement, has

a total capacity of 2,000 kw, and comprises 4 400-kw generators, direct-connected to horizontal tandem compound Corliss engines, and two 200-kw generators direct-connected to horizontal tandem compound high-speed engines. The engines are run non-condensing at 130 pounds initial pressure. The equipment of the dynamo panel differs from the usual arrangement in several respects; in the first place, the equalizer bus-bar, usually placed at the back of the dynamo panel, is omitted, the equalizer connections between the dynamos being made at automatic switches near the dynamos; the second departure from the usual practice is the omission of the dynamo main three-pole switches; each of these switches is replaced by a small knife-switch and small circuit-breaker, which control the operating circuit and the 3-pole automatic electro-magnetic dynamo switch located near each dynamo. Altogether there are 11,000 incandescent lamps and 1,200 enclosed arc lamps.—*Am. Elec.*, February.

WIRES, WIRING AND CONDUITS.

Distribution of the Current in a Network of Wire.—FEUSSNER.—An account of an investigation founded upon Kirchhoff's laws as basis for calculating the distribution of currents in a network of wires. These laws permit in any case of the formation of a system of linear equations from which the current strength in each wire may be obtained as the quotient of two determinants. The author develops a method of simplifying the calculation of more complicated cases. He calls N the common denominator of all the different currents in a network, and formulates a number of theories involving this quantity. Thus the resistance of any given network between two points, A and B, is obtained by dividing the N of the network by the N of another network produced by joining the points, A and B. Moreover, the N of a network which may be split up into partial nets with or without connecting wires, is a sum whose first term is the product of the sum of the resistances of the connecting wires into the $N's$ of all partial nets, while the terms which follow are the same products with the $N's$ replaced by the $N's$ of the same nets with their junctions together.—*Ann. d. Phys.*, 1902, No. 13; abstracted in Lond. *Elec.*, January 23.

REFERENCES.

Cable Conduits.—SCHMIDT.—The first part of a long and well-illustrated article on details of the mechanical construction of conduits for underground cables, and in general of such devices which are used for protecting underground cables against injuries.—*Elek. Zeit.*, January 22.

Three-Wire Direct-Current Wiring.—PERCY.—An article with illustrations and wiring tables for the 3-wire system of distribution. —*Am. Elec.*, February.

ELECTRO-PHYSICS AND MAGNETISM.

Graphical Methods for Alternating-Current Phenomena.—ORLICH.—An article on the limitations of the graphical methods. The representation of alternating-current values by means of geometrical vectors was originally based on the assumption of pure sine waves. This method was later applied to the general case of any wave form, the length of a vector being assumed to represent the effective value; but it was found that this method cannot be strictly correct in the general case. The present author discusses the graphical representation of the 3-star e.m.f's of a 3-phase system, and proves that a generally correct treatment is impossible by a graphical method; the only assumptions which he makes for the graphical method are that the length of a vector equals the effective value and that the law of the geometrical addition of vectors is fulfilled. He proves that a generally correct representation of the facts by graphical methods is impossible, even if the vectors are not limited to a plane, but to a space of three dimensions.—*Elec. Zeit.*, January 22.

Principles of the Dynamics of the Electron.—ABRAHAM.—A long theoretical paper in which he formulates the equations governing the motion of an electron. He assumes the latter to be a rigid spherical particle carrying the electricity uniformly distributed over its surface or through its volume. He assumes with Kaufmann that these spheres whose radius is about a billionth of a millimeter, have no mass in the ordinary sense. Their inertia is of a purely electro-magnetic nature, and is different for forces along and across the line of motion. He shows by means of vector analysis that Newton's first axiom applies to the electron in the following form: If its motion was from the beginning a uniform motion of pure translation, and if the velocity is less than that of light, then no external force is necessary to keep the motion uniform. If the velocity of the electron is no longer small in comparison with the velocity of light, the impulse is no longer proportional to the velocity. The longitudinal and transverse masses depend in a different manner upon the velocity. The author sees nothing in the way of building up a complete system of mechanics upon an electro-magnetic basis. —*Ann. d. Phys.*, 1903, No. 1; abstracted in Lond. *Elec.*, January 23.

Discharge in an Electric Field.—CANTOR.—An account of an investigation of the influence of an electric field upon a discharge potential. When a spark-gap is immersed in a transverse electrostatic field, the discharge potential is reduced, and this is the case not only when the field is steady, but also when it is alternating. He produced the alternating field by a condenser fed by an induction coil and attached the wire conveying the condenser discharge to a tube which contained the spark-gap; it was then found that the discharge potential of the latter fell from 3,200 to 2,200 volts. In another experiment two copper discs 100 mm in diameter were mounted at a distance of 40 mm apart and insulated. One of them was then connected with the wire conveying the alternating discharge, while the other was connected with the knob of an electroscope. A positive charge of the eletctroscope was maintained intact, but a negative charge was quickly dissipated; there was no trace of a discharge between the plates, nor was any difference made by introducing a slab of paraffin between the plates. In all these respects, therefore, the alternating electric field produces the same action as would be produced by ultra-violet light. The electric oscillations used had a wave-length of about 100 meters.—*Ann. d. Phys.*, 1903, No. 1; abstracted in Lond. *Elec.*, January 23.

REFERENCE.

Thermomagnetic Properties of Bismuth.—LOWNDES.—An account of an investigation of the change of electrical resistance in the magnetic field, the Hall effect, and the conductivity for heat in and out of the magnetic field for the same crystal specimen of bismuth, the temperatures ranging from 22° to 186°.—*Phil. Mag.*, January; abstracted in Lond. *Elec.*, January 23.

ELECTRO-CHEMISTRY AND BATTERIES.

Electrolytic Rectifier.—An illustrated description of an electrolytic rectifier developed by the French engineer Nodon and now being put on the market. The construction is extremely simple and consists merely of a hollow cylinder of a zinc-alluminum alloy, immersed in a solution of ammonium phosphate; an iron containing vessel forms the other electrode. A few minutes after starting a film commences to form on the surface of the aluminum electrode; it is this film which permits current to pass in one direction only. In order to utilize both half-waves of the alternating current the well-known Graetz arrangement is used, as shown in a diagram. With polyphase systems it is necessary to use a number of cells equal to twice the number of wires used in distribution. Each cell may be used for 50 to 140 volts; for higher voltages two or more cells must be connected in series, allowing 140 volts as a maximum for each cell. Regulation in connection with these valves having a capacity of more than 4 kw may be effected either by a choking coil on the alternating-current side of the apparatus or by the adjustment of insulating sleeves, which may be made to cover or expose the aluminum-zinc cylinders at will. The efficiency is claimed to remain practically constant at 75 per cent. for all loads, the loss consisting in a reduction of 10 to 12 per cent. of the e.m.f., and a leakage of alternating current within the rectifier corresponding to from 10 to 12 per cent. of the energy utilized; this lost energy is dissipated as heat, which raises the temperature to almost 50° C. The frequency within ordinary limits appears to have no effect on the efficiency of the apparatus. The apparatus is provided with a fan for forcing cooling air through the aluminum cylinders, which are made hollow. The current density is about 5 amp per square decimeter of active surface of aluminum. Nodon has also designed an electrolytic condenser of considerable capacity on the same principle, for use in starting alternating-current motors and for similar purposes.—Lond. *Elec.*, January 23.

E.M.F. of Daniell Cell.—CARHART.—An article in which he discusses the problem why the e.m.f. of the Daniell cell changes with the density of the solutions. He had formerly given a new explanation of the dependence of the e.m.f. of a Daniell cell on the concentration of the two solutions, this explanation being based on the fact that the thermo-electromotive force between a metal and a solution of one of its salts, increases with the concentration of the solution. J. W. Richards has offered another explanation, based

upon the variation in the heat of formations of zinc and copper sulphates with the concentration. The present author describes some experiments which he has recently made and which appear to him to be decisive as to the competency of his own explanation, although he does not claim that his explanation excludes others when the subject is approached from a different point of view. He measured the e.m.f. of a Daniell cell in two cases in which the zinc sulphate solution was first one-sixteenth normal and later a normal solution; the difference of the e.m.f's in both cases was found to be 0.021 volt at 20° C. The value calculated from the thermo-electromotive forces at the zinc plate is 0.029 volt; hence the thermal electromotive forces are ample to account for the observed variation in the e.m.f. of the cell. The change in the e.m.f. of a Daniell cell when one zinc sulphate solution is substituted for the other is the same as the e.m.f. of a concentration cell set up with zinc electrodes and the two solutions; this was proven experimentally by joining two Daniell cells with different concentrations of the zinc sulphate in opposition and adding in series with them a zinc sulphate concentration cell set up with the same solutions; the 3 cells balance within 1/1000 volt; he remarks that this fact is not in agreement with a theorem of Nernst. Ideally, a concentration cell is one containing no internal chemical energy to be transformed; this is the case when the solutions are so dilute that they generate no heat when mixed; the heat of dilution is then negligible, and the first term of the Gibbs-Helmholtz equation is zero, while the second one, involving the absolute temperature and the temperature co-efficient is the sole expression of the e.m.f.; but the temperature co-efficient is the sum of all the thermo-electromotive forces at the several junctions in the cell, all taken with their proper signs. Such a cell converts heat into electrical energy. At the limit when there is no internal chemical energy, all the heat is absorbed from the surroundings.—*Electrochem. Ind.*, January.

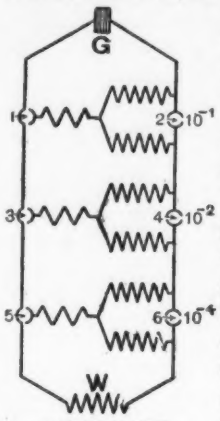
Aluminum.—Burgess and Hambuechen.—An article giving some laboratory observations on aluminum. The authors show the great influence which the ever-present, thin, invisible film on an aluminum surface has upon the success of various operations. This film is supposed to have considerable strength and continuity, and if it is broken or removed by mechanical means the aluminum immediately forms a new one. In soldering aluminum the principal difficulty seems to be due to the failure of the alloy used as a solder to adhere to the aluminum, a condition attributable to the protective film which must be eliminated before the metals can unite. A successful solder consists of about 21 per cent. of zinc, 76 per cent. of tin and 3 per cent. of aluminum; it may be applied directly to a cleaned aluminum surface without the use of a flux, and at a temperature but little above that which is necessary for soldering copper or iron. There are certain advantages in the apparent complication which the use of a flux involves; a suitable solvent for the oxide film increases the rapidity of the soldering process, increases the certainty of adhesion and enables cheaper soldering mixtures to be used. The requirement for such a flux is that it should dissolve the coating and leave a clean surface for the solder to unite with, upon application of heat; it seems that water cannot be a component of a suitable flux. A material which, for certain solders, forms an admirable flux, is stearic acid; by applying it to a freshly-scraped aluminum surface and then applying a tin-lead-zinc alloy, the matter of soldering aluminum presents scarcely greater difficulties than does the soldering of other metals. This almost ever-present coating upon aluminum is also the source of difficulty in the deposition of a permanent coating of other metals upon aluminum surfaces; while it is very easy to deposit a layer of metal upon aluminum from almost any plating solution, in the great majority of operations the resulting coating can be readily removed; sometimes in remarkably thin and continuous layers. The prime requisite in successful depositions on aluminum is the complete removal of the protection film, so that the electro-deposited metal may be applied over the complete surface of and in intimate contact with the aluminum; if this condition is fulfilled, and the coating is non-porous, it will be durable. The converse of this operation, i. e., the electro-deposition of aluminum upon other metals, appears to be impossible from aqueous solution. From the fact that, for equal weights, aluminum possesses about four times the energy as does zinc, considerable attention has been given to the problem of substituting aluminum for zinc in primary cells; but as a matter of fact, aluminum does not behave well as the electro-positive metal of a battery and attempts to use it in practice have almost universally failed. The results of measurements made by Mott, of the potential of aluminum in various electrolytes (measured against a normal electrode) are given in diagrams and tables. It appears that, of the various materials tested, ammonium fluoride would be the best material to use in connection with aluminum for battery purposes.—*Electrochem. Ind.*, January.

REFERENCE.

Aluminum as a Reducing Agent in Metallurgy.—Scholl.—An illustrated article on the theory and the various applications of the well-known Goldschmidt process.—*Electrochem. Ind.*, January.

Units, Measurements and Instruments.

Movable-Coil Galvanometers.—Volkmann.—A paper on the use of the movable-coil galvanometer, which, since the rapid expansion of electric tramways, has been largely introduced in laboratories because it is comparatively unaffected by external disturbances. But its use requires many precautions with which the physicist is not yet familiar, the most puzzling thing being the effect of the resistance in the circuit upon the sensitiveness. If the latter is reduced by inserting a high resistance, the damping is inconveniently diminished; the expedient of shunting, on the other hand, usually produces excessive damping. The author gives some hints as to how to combine shunting and series resistance in a generally effective manner; every change of sensitiveness should leave the damping and the resistance in the circuit as they were before. The adjoining diagram represents a combined shunt and resistance box in which three plugs are sufficient to produce the following eight degrees of sensitiveness:



MOVABLE-COIL GALVANOMETER.

Plugs in.			Sensitiveness.
2	4	6	1
1	4	6	0.1
2	3	6	0.01
1	3	6	0.001
2	4	5	0.0001
1	4	5	0.00001
2	3	5	0.000001
1	3	5	0.0000001

—*Ann. d. Phys.*, 1903, No. 1; abstracted in Lond. *Elec.*, January 23.

REFERENCES.

Prony Brakes for Motor Testing.—An illustrated article with elaborate tables, on the Prony brake; the tables giving weights corresponding to various horse-powers and speeds, with different lengths of brake-arm.—*Am. Elec.*, February.

Construction of the D'Arsonval Mirror Galvanometer.—Cerny.—An article with dimensional drawings on the construction of a self-adjusting D'Arsonval galvanometer, the main features of which were taken from one made by Ducretet.—*Am. Elec.*, February.

Miscellaneous.

Vortex Lightning.—Klingelfuss.—A description of a new kind of lightning discharge which was discovered by him by means of photography. The reproduction shows a series of spirals resembling twisted columns of light mapped out by parallel screw lines, of which some 50 or 60 go to the thread. The photograph was obtained at Basel during a thunderstorm last summer. The direction of the discharge was from north to south, in the magnetic meridian. The author reproduces for comparison one of Ruhmer's photographs of a spiral discharge obtained with an induction coil and a liquid interrupter, but this is by no means as perfectly spiral as the lightning flash. The photograph of the latter is incidentally interesting as showing that the discharge was not alternating, but pulsating, since otherwise the vortices could not have been produced. The simultaneous magnetic records at Potsdam showed no extraordinary variation of the magnetic elements.—*Ann. d. Phys.*, 1903, No. 1; abstracted in Lond. *Elec.*, January 23.

New Books.

BOOKS RECEIVED.

DIE KUNSTLICHEN KOHLEN. Fur Elektrotechnische und Elektrochemische znecke, ihre herstellung und prufung. By Dr. Julius Zellner. Berlin: Julius Springer. 295 pages, 102 illustrations. Price, 9.20 marks.

ELEKTRO-INGENIEUR KANENDER. 1903. By Arthur H. Hirsch and Franz Wilkins. Berlin: Oscar Coblentz. 287 pages, illustrated. Price, 2.50 marks.

SAMMLUNG VON LEILUNGO-SKIZZEN FOR SCHWASTROM ANLAGEN. By C. Erfurth. Vienna: A. Hartleben. 81 plates. Price, 3 marks.

EINFUHRUNG IN DIE ELEKTROCHEMIE. Nach der Elektrolytischen Dissociationstheorie. By Peter Gordes. Halle: Wilhelm Knapp. 124 pages, 48 illustrations. Price, 4 marks.

SPECIELLE ELEKTROCHEMIE. Handbuch der Electrochemie. By Dr. H. Danneel. Halle: Wilhelm Knapp. 80 pages. Price, 3 marks.

ELECTRICAL PROBLEMS. By Prof. William L. Hooper. Boston: Ginn & Co. 170 pages, illustrated. Price, $1.35.

Directory of Electrical Societies, Etc.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, Secretary, Ralph W. Pope, 95 Liberty Street, New York. Meetings: February 27th, "Railway Train Lighting," Wm. L. Bliss, Lamar Lyndon and A. J. Farnsworth; March 27th, "High-Tension Lines," Ralph D. Mershon; April 24th, "Tendencies of Central Station Development," H. A. Lardner, Philippo Torchio and Peter Junkersfeld.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES, Secretary, W. H. Johnson, Philadelphia, Pa.

CANADIAN ELECTRICAL ASSOCIATION, Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Toronto, Ont., 1903.

THE ELECTRICAL TRADES SOCIETY (Member National Electrical Trades Association), Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets every second Friday of each month.

ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE, Secretary, Wm. J. Davis, Ithaca, N. Y.

ENGINE BUILDERS' ASSOCIATION, F. P. Ide, Springfield, Ill., Secretary.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS, Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Atlantic City, N. J., September, 1903.

INTERSTATE INDEPENDENT TELEPHONE ASSOCIATION, Secretary, E. M. Coleman, Louisville, Ky.

KENTUCKY INDEPENDENT TELEPHONE ASSOCIATION, Secretary, H. K. Cole, of Lancaster, Ky.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES, Secretary, W. H. Morton, Utica, N. Y. Next meeting, Detroit, Mich., July 15, 1903.

NATIONAL ELECTRIC LIGHT ASSOCIATION, Secretary, James B. Cahoon, 136 Liberty Street, New York. Next meeting, Chicago, May, 1903.

NEW YORK ELECTRICAL SOCIETY, Secretary, G. H. Guy, 114 Liberty Street, New York. Next meeting, February 18, American Institute. Illustrated Lecture by Dr. A. E. Kennelly, "Submarine Cables."

NORTHWESTERN ELECTRICAL ASSOCIATION, Secretary, T. R. Mercein, 85 Michigan Street, Milwaukee, Wis.

SOUTHERN INDIANA TELEPHONE ASSOCIATION, Secretary, E. W. Pichardt, Huntingburg, Ind.

New Telephone Equipment.

The telephone instrument shown herewith is made up with a solid bronze standard, heavily nickeled, and is fitted with improved concealed contacts covered by a slip shell so that they are easily accessible when it is desired to examine them. These contacts are an improvement over the butting type generally used on this style of a telephone, they being placed side by side, which allows of a positive rubbing contact. They are also made with insulated hook and insulated under contact where so desired for battery, call or special work. The base is made so that the induction coil can be mounted therein. If, however, they are desired with induction coil mounted on a terminal block, a

DESK TELEPHONE.

terminal block is supplied with incased coil for this purpose. This apparatus is supplied by the Connecticut Telephone & Electric Company, Meriden, Conn.

The Protection of Street Car Motors.

Perhaps the best appliance for protecting a street car equipment from too great overloads is the automatic circuit-breaker, serving, also, as a canopy switch when installed within easy reach of the motorman. The great advantage of this arrangement is that it is easily accessible, can be quickly closed and is in no way dangerous, thus avoiding the usual delay and risk incident to replacing a fuse.

Where it is not thought advisable to incur the expense of equipping all the cars of a line with automatic circuit-breakers, the next best thing is a fuse block possessing the same qualities of easy accessibility, replaceability and freedom from danger. The fuse block

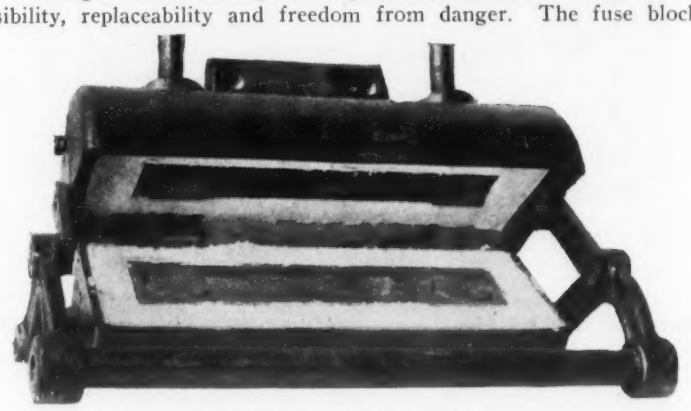


FIG. I.—FUSE BLOCK OPEN.

shown in the accompanying illustration can be easily gotten at for renewing the fuse and, when open, the contacts on which the fuse is supported are cut out of the circuit, making it perfectly safe to replace the fuse while the line is alive. A straight piece of copper wire is used as a fuse and is secured in place and clamped in the contacts by the act of closing the block. When a fuse blows, all that is necessary is to open the block, drop a piece of straight copper

wire in place, and then close it again. The fuse block shown herewith, which is made by the Westinghouse Electric & Manufacturing Company, is iron clad, being completely enclosed in an iron casing, excepting where the vent for the arc extends through the bottom.

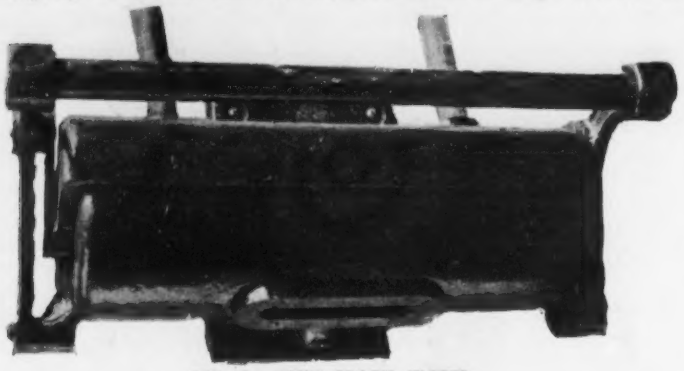


FIG. 2.—FUSE BLOCK CLOSED.

The Westinghouse Company also manufactures an automatic car circuit-breaker, which has given excellent satisfaction in the protection of car equipments.

Integrating Direct-Current Wattmeters.

Some months ago (May 17, 1902) we printed an account of 57 meter patents granted in one issue to Mr. Thomas Duncan, and embodying a number of new principles in meter construction. Meters under these patents are now being manufactured by the Duncan Electric Mfg. Co., of Lafayette, Ind., and we give below a description of the direct-current integrating wattmeter type. The meter represents the work of years of experience and is designed to meet every requirement of those whose duty it is in the central station to test, install and inspect meters, that their work may be facilitated, and assist in keeping the operating expense of the meter department at a minimum.

The castings of the meter are made from nickel aluminum, making it light in weight, while every part is easy of access and interchangeable. The terminals are at the top of the meter and connect the series coils with the inleading wires from the circuit, thereby

FIG. 1.—METER ENCASED.

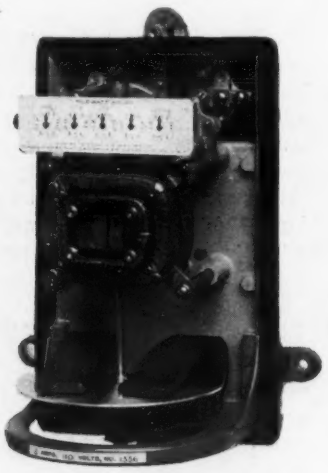


FIG. 2.—CASE REMOVED.

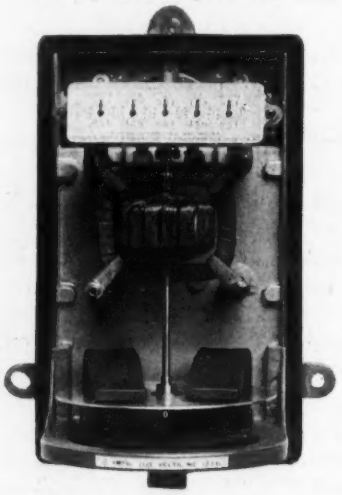


FIG. 3.—FRONT, SERIES COIL REMOVED TO INSPECT ARMATURE.

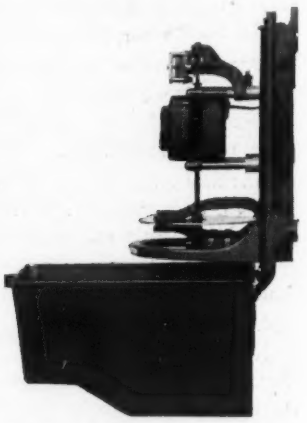


FIG. 4.—SIDE VIEW SHOWING DETACHABLE AND HINGED CASE.

removing these leads away from the retarding magnets at the bottom, and insuring in consequence a greater permanency and life for the magnets—something impossible when the inleading wires enter a meter quite close to the retarding magnets owing to the magnetic field they set up exerting a demagnetizing effect upon the magnets when in close proximity thereto, and which becomes very pronounced in case of heavy overloads and short circuits.

The registering train is made large, and all of its parts are carefully adjusted to insure perfect ease of operation and freedom from "sticking" which creates so much trouble in smaller trains, even to stopping the meter. The pinions and gear wheels are cut very accurately by automatic machinery, and assembled by experienced watchmakers. It is provided with dowel pins, so that when it becomes necessary to remove it from its bracket, it can be again put back exactly into its position, thereby enabling the worm wheel and worm to mesh as originally set. The dial is also much larger than is usually employed, making it easy to read at a distance, and has a porcelain face. The circles and figures are printed in heavy type and read in kilowatt hours, or dials can also be furnished to read in watt-hours, horse-power-hours, board of trade units or dollars and cents.

A feature of the meter is that it is direct reading, that is, the dial shows at all times the actual amount of energy that has been consumed without having to employ a "constant" or "multiplier" by which the reading would otherwise have to be multiplied.

The cast back or support of the meter is provided around its outer edge with a groove that is lined with heavy felt and over which the case closely fits, thereby rendering the meter dust and insect-proof. The dust-proof case is hinged at the bottom and is provided with a single screw at the top, which answers for screwing it tightly into position and sealing the meter at the same time.

The series coils are machine-wound and heavily insulated with linen tape, after which they are immersed in copal varnish then baked for several hours until they are thoroughly dry. This enables them to withstand any commercial pressure without breaking down. The front series coil can very easily be removed from the meter by simply taking out the four screws that hold its corner clamps to the brass supporting rods. This removable feature of the front coil furnishes a quick and excellent means for inspecting the armature. The resistance wire is wound in sections upon a flat insulated support having saw-tooth edges, so that the difference of potential between each adjacent section is reduced to a minimum.

The commutator is made of a special alloy which will retain its polish even in the presence of sulphurous gases. The segments are accurately cut and thoroughly insulated from each other and from the spindle so as to prevent any possibility of the armature circuit becoming grounded at this point. The brushes are easily detached by the removal of two small screws, which permits of their being lifted out for inspection without interfering in any way with the shunt circuit wires. When they are detached they can be thoroughly cleaned and polished if necessary and replaced again without any fear whatever of changing their original tension; something quite essential.

The spindle is provided with a removable pivot point, which is made from the best quality of steel piano wire hardened in mercury, then polished to a very fine finish with Vienna lime and rouge. The point of these pivots is carefully rounded off by a machine expressly designed for the purpose, so as to give the least tendency to wear and at the same time reduce the friction to a minimum. The Duncan company has succeeded in procuring an especially high grade of Ceylon sapphire that comes next to the diamond in hardness. They are made in accordance with a special design, and polished until they are entirely free from scratches or flaws of any kind. The size and form of the cup is such as to give the best possible results with the aforementioned pivot point, resulting in low friction and long life. To protect the jewel against jarring

and vibration, it is seated upon a small spring, which is adjusted to exactly balance the weight of the revolving element; and upon the slightest jar being imparted to the meter the spring takes it up and relieves the jewel from any possibility of being damaged.

To those who wish to use the best bearing possible, the makers of this meter can furnish a diamond jewel bearing. It consists of a diamond step having a sapphire guide mounted upon it, and within which the spindle point revolves, the whole being seated upon a delicately adjusted spring to protect it against jarring in a manner similar to that of the sapphire bearing. Tests of meters equipped with these diamond jewels have demonstrated that as many as five million revolutions of the spindle with its accompanying armature and retarding disc, failed to produce the same wearing effect that usually results with a sapphire jewel and one-tenth the number of revolutions.

Realizing the importance of having retarding magnets that will withstand variations in temperature and mechanical vibration incident to shipping and handling and still maintain their strength for the purpose of enabling the meter to remain accurate for an indefinite period, the manufacturers have given a great deal of study, and made many experiments with the view of producing magnets whose permanency or magnetic retentivity could be relied upon.

The usual means to compensate for the changes in friction of the meter, is also provided to insure low load accuracy. This consists of a small coil wound with many turns of fine wire and connected in series in the armature circuit and placed within the front series coil adjacent to the armature. It is held in position by four small wire brackets and thumb nuts, which prevent it from changing its position during shipment.

The testing constant (K) of each meter is marked upon the disc. This testing constant is used only in testing the meter. The dials are direct reading and do not require any constants.

This meter, while especially adapted for measuring the energy or direct-current lighting and power circuits, will also accurately measure alternating currents of any power factor, wave form, or frequency. This is made possible by its being of the commutated type without iron in its series coils or armature, and its pressure current practically free from inductance.

10,000-Volt Motor-Generator

We show herewith a view of the sub-station from which the San Bernardino Valley Traction Company obtains the power for its lines running from San Bernardino to Colton, Cal. Current is supplied to the sub-stations from a 10,000-volt distributing line of the Edison Electric Company, of Los Angeles, the current in this line having been stepped down from 33,000 volts, the voltage of generation.

Fig. 2 shows a plan and section of the motor-generator set in the sub-station, made by the Bullock Electric Manufacturing Company. This consists of a 200-kw direct-current street railway generator running at 500 r.p.m., direct-connected to a 10,000-volt, 50-cycle, 3-phase synchronous motor. The motor, which is of the revolving field type, is so built that the field may be easily removed from within the armature frame should the armature coils require inspection or repair. The machine is of sufficient size to supply extensions of the railway to Highland and Redlands, which will shortly be constructed. The motor has a single coil per phase, and is started from the direct-current side by means of a small rotary converter. The current supplied to the motor is measured by a Thomson 10,000-volt polyphase wattmeter.

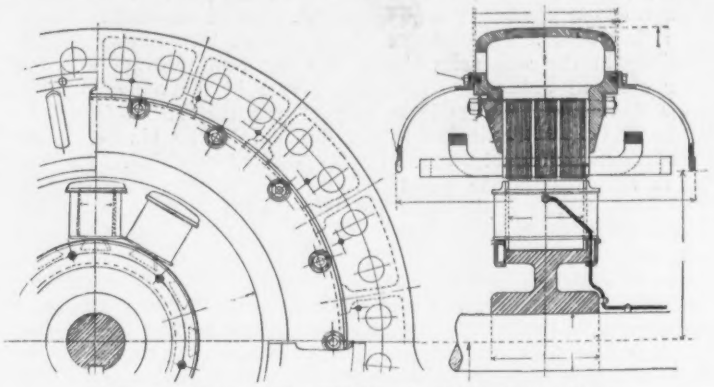


FIG. 2.—PLAN AND SECTION OF MOTOR GENERATOR.

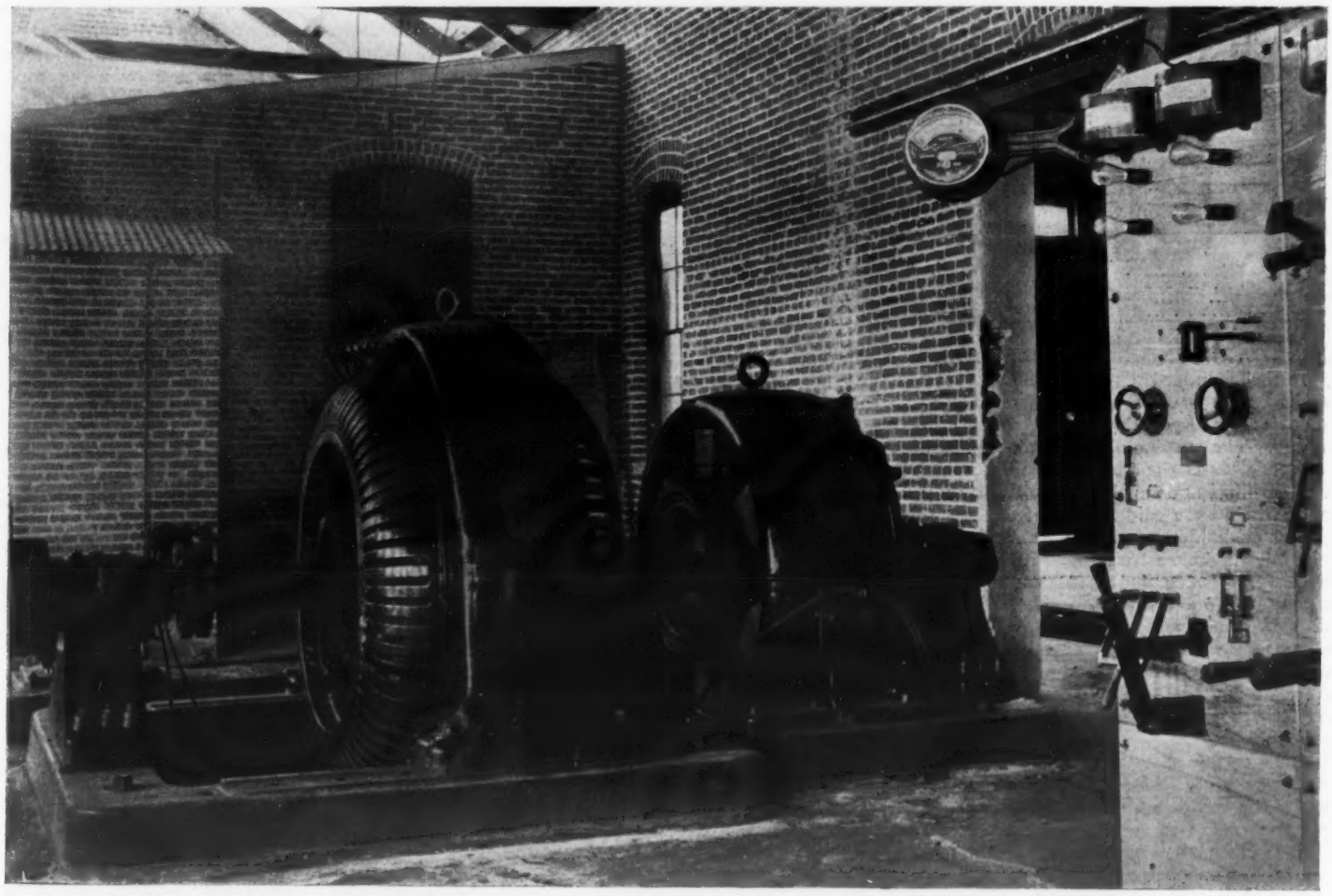


FIG. 1.—THREE-PHASE MOTOR GENERATOR IN SUB-STATION OF SAN BERNARDINO VALLEY TRACTION COMPANY.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Money was easier throughout the week and freely offered, closing at 4½ per cent. for 60 to 90 days, 4½ a 5 for 4, 5 and 6 months. While the stock market was rather dull, it presented an appearance of increasing strength, especially in the anthracite shares, the standard railways and the better class of industrials. Increasing ease in the money market was a dominant factor and the market was favorably affected by various developments including the decision in the United States Steel litigation. Amalgamated Copper showed much strength, the rise in the price of the metal having undoubtedly caused support to be given by the inside interests. The change in the management of the Brooklyn Rapid Transit Company was favorably regarded and caused buying of that stock, which had a good effect on traction shares as a group. Brooklyn Rapid Transit closed at 68⅞, being a net gain of 1½ points, and Metropolitan Street Railway at 137, a net gain of ½ point. General Electric closed with a net loss of 3¼ points, at 193¾, and Westinghouse common at 213¾, ex-div. Western Union kept steady throughout the week, fluctuating within very narrow limits and closing at 90. Other closing quotations and net changes were: American Telephone & Telegraph, 163⅛, a loss of 2⅜; American Telegraph & Cable, 86⅛, a loss of 7⅝, and American District Telegraph, 38½, a gain of 1½. Following are the closing quotations of February 10:

NEW YORK.

	Feb. 3.	Feb. 10		Feb. 3.	Feb. 10
American Tel. & Cable	86	85	General Electric	192¾	195⅛
American Tel. & Tel.	162	164	Hudson River Tel.	...	...
American Dist. Tel.	37	37	Metropolitan St. Ry.	137⅝	137⅝
Brooklyn Rapid Transit	67¾	69¼	N. E. Elec. Veh. Trus.	1/8	1/8
Commercial Cable	..	..	N. Y. & N. J. Tel.	162	162
Electric Boat	20	20	N. Y. E. V. T. Co.	10	10
Electric Boat pfd.	37	37	Tel. & Tel. Co. Am	...	...
Electric Lead Reduction	3	3	Western Union Tel.	89¾	89⅝
Electric Vehicle	7	6	Westinghouse com.	214	210
Electric Vehicle pfd.	12¾	11½	Westinghouse pfd.	210	210

BOSTON.

	Feb. 3.	Feb. 10		Feb. 3.	Feb. 10
American Tel. & Tel	181¾	184¾	Western Tel. & Tel. pfd.	98	90
Cumberland Telephone	..	..	Mexican Telephone	2¼	2¼
Edison Elec. Illum.	..	..	New England Telephone	137	135
General Electric	..	194¼	Westinghouse	106	105
Western Tel. & Tel.	24	24	Westinghouse pfd.	107	105

PHILADELPHIA.

	Feb. 3.	Feb. 10		Feb. 3.	Feb. 10
American Railways	..	..	Phila. Traction	98	98
Elec. Storage Battery	..	..	Phila. Electric	7⅞	8
Elec. Storage Battery pfd.	..	..	Pa. Electric Vehicle	..	..
Elec. Co. of America	9¼	9¼	Pa. Electric Vehicle pfd	..	..

CHICAGO.

	Feb. 3.	Feb. 10		Feb. 3.	Feb. 10
Central Union Tel.	..	..	National Carbon pfd.	98	98
Chicago Edison	162¼	160	Northwest Elev. com.	..	..
Chicago City Ry.	235	225	Union Traction	9	10¾
Chicago Tel. Co.	158	..	Union Traction pfd.	40	35
National Carbon	24	24			

STANDARD UNDERGROUND CABLE.—At the annual meeting of the Standard Underground Cable Company it was shown that the earnings of last year aggregated $3,984,531, an increase of $664,000 over the year before, and the greatest in the history of the company. The surplus of the company has been swelled to $760,350. It was $265,564 at the opening of 1901. Since then the company has, out of earnings and surplus, made tremendous additions to its plants, part of which were paid for out of the proceeds of a new stock issue. At the stockholders' annual meeting in the offices of the company in the Westinghouse Building, Pittsburg, 17,947 shares out of 20,000 shares were represented in person or by proxy. During 1902 the company paid one extra dividend of 2 per cent. aggregating $154,862. This was in addition to regular quarterly dividends of 2 per cent. The company's consumption of copper wire in 1902 was 8,200,000 pounds and of lead 18,126,000 pounds. This was used in its manufacture of underground, submarine and aerial cables for all classes of electric work at the plants in Pittsburg, Oakland, Cal., and Perth Amboy, N. J. The new and extensive copper rod and wire mills built during the past year at Perth Amboy, N. J., have gone into operation, and will hereafter produce from the copper bars the wire used by the company in the manufacture of its cables and insulated wires and some will go to the market. The new mills are housed in buildings covering a ground space of 300 x 180 feet, a portion being three stories and basement in height.

COMMERCIAL CABLE.—The $1,666,000 of the capital stock of Commercial Cable Company, to list which on the Stock Exchange application has been made, is the stock that was in the treasury until a couple of weeks ago, when the directors authorized it to be issued in order to use the proceeds in paying for the Pacific cable. Including this amount, the outstanding stock amounts to $15,000,000. An additional $10,000,000 will be authorized at a special meeting of the stockholders to be held before long, which will bring the total authorized capitalization up to $25,000,000. It has not been definitely stated for what purpose the $10,000,000 of new stock may be used, but it is presumed that it will be issued from time to time in connection with executing the plan of the company.

HOUSTON ELECTRIC.—Houston Electric Company, of Texas, reports as follows for the year ended December 31:

	1902.	1901.	Changes.
Gross	$360,017	$292,744	Inc. $67,273
Exp. and taxes	210,772	177,363	Inc. 33,409
Net	$149,245	$115,381	Inc. $33,864
Interest	75,000	.....	.....
Surplus	$74,245	.....	.....

MINNEAPOLIS GENERAL ELECTRIC reports for the year ended December 31 as follows:

	1902.	1901.	Changes.
Gross	$500,586	$425,164	Inc. $75,422
Expenses	265,444	222,030	Inc. 43,414
Net	$235,142	$203,131	Inc. $32,008
Charges	98,410	97,046	Inc. 1,364
Surplus	$136,732	$106,088	Inc. $30,644

THE SAVANNAH ELECTRIC COMPANY, of Savannah, Ga., reports as follows for the year ended December 31:

	1902.	1901.	Changes.
Gross	$480,510	$434,293	Inc. $46,217
Expenses and Taxes	267,991	264,992	Inc. 2,999
Net	$212,519	$169,301	Inc. $43,218
Interest	115,000	.....	.....
Surplus	$97,519	.....	.....

WHAT ELECTRICITY CAN DO.—The quarterly report of the Manhattan Railway Company for the period ended December 31—when complaints of overcrowding were loudest—shows that no fewer than 64,822,675 passengers were carried, an increase over the corresponding quarter a year ago of 7,596,825, while gross earnings increased $374,224 and net $423,559—this in spite of the fact that the increased cost of fuel for the quarter was $150,000.

Commercial Intelligence.

THE WEEK IN TRADE.—Most favorable conditions continue in practically all lines of trade and industry and from all sections of the country come reports of a large volume of business for this season of the year. Referring to these conditions, *Bradstreet's* says: "Confirmation of fine January trade reports is had in the largest aggregate of clearings ever reported in that month (despite dull stock speculation) and the smallest total of January failures recorded for ten years past. Spring trade * * is earlier and of larger volume than in any previous year, and the remarkable steadiness in prices is evidence that stability in present conditions is expected for some time to come." The recent spell of mild weather has brought about an improvement in the coal situation. Better net returns of railway earnings are made, while gross receipts are increasing largely. In the Central West business has been of good volume, despite the interference resulting from heavy storms; on the Pacific coast cold weather has retarded business somewhat; in the Northwest jobbing distribution for spring account was of goodly volume, and in the South trade was of fair proportions, being specially active in machinery, lumber and naval stores. In the East trade is of good volume. In iron and steel finished products continue as active as heretofore, rails, structural materials, wire, bars and railway material being in active request. There are orders on the books for 5,500,000 tons, the largest future business on record. The copper market was firm, with higher prices, although little activity was shown by purchasers. Lake and electrolytic are quoted at 12.37½c. a 12.62½c.; casting stock, 12.25c. a 12.50c., and Standard, 11.87½c. The number of business failures for the week ending February 5, as reported by *Bradstreet's*, aggregated 208, as against 230 the previous week, and 247 the corresponding week last year.

SOME C. & C. ORDERS.—The C. & C. Electric Company, 143 Liberty Street, New York, has taken a contract from the William Wharton, Jr., Company, manufacturer of frogs and switches, Philadelphia, for several motors varying in capacity from 2 hp to 40 hp; a 40-kw generator and a 75-kw generator, complete, with switchboards, etc. The smaller generator will be operated by a 12-in by 12-in. engine, to be supplied by the Watertown Engine Company. The larger generator will be direct connected to a 14-in. by 14-in. Watertown engine. The machinery is intended for power purposes. Six C. & C. motors varying from 4 hp to 50 hp will be put in the new Berkeley Building, Broad Street, New York. They will be used for driving ventilators to be installed by the B. F. Sturtevant Company. The Gould Storage Battery Company, of 18-20 West Thirty-fourth Street, New York, has ordered a 20-kw 3-machine booster for its Depew (N. Y.) plant. Two 30-hp slow-speed motors will be used for operating Sturtevant ventilators in the Ethical Culture School, 109 W. Fifty-fourth Street, New York. The Standard Steel Works, of Burnham, Pa., has sent in its eighth order within three months, to the C. & C. people for a 50-hp motor. A repeat order—the fifth—has also been received from the High Point (N. C.) Machine Works for a 120-kw belted generator for central station work. The Quebec Steamship Company's new steamer now being built in England for the New York-Bermuda service is to be furnished with a 16½-kw generating set for lighting purposes. The engine will be manufactured by the New York Safety Steam Power Company, 113 Liberty Street. The Seaboard Realty Company, of 127 West Forty-second Street, New York, has ordered two 30-kw generators and three switchboards, which will serve as lighting equipment in new up-town hotels. Strouss, Eisendrath & Co., manufacturing clothiers, Chicago, have requisitioned for 13 floor-type motors for connection by line shafting to sewing machines. The motors vary in capacity from 2 hp to 5 hp.

THE NORTHERN ELECTRICAL MANUFACTURING COMPANY, of Madison, Wis., has just completed and is now operating a power plant for the generation of the power and lighting current required in its works. There are two generating units—a 200-kw Northern Dynamo, direct connected to a 225-hp Vilter-Corliss engine at 100 r.p.m., and a 50-kw Northern Dynamo, direct connected to a 75-hp Ball engine at 290 r.p.m. The large generator is used for the day load, while the small machine supplies the current for operating the machinery and furnishes light required by the night shift. Two 250-hp boilers constitute the steam plant, using a Cochrane feed water heater. A 120-foot steel stack is used. The current is carried from a six-panel marble switchboard through a tunnel into the distributing board in the shop. Exhaust steam is used for heating the works. The power plant is housed in a new brick wing, 87 ft. 8 in. x 100 ft. 4 in. An additional wing 38 ft. x 100 ft. 4 in. was constructed simultaneously; the additions accommodate—in addition to the generating station—paint shop, pattern shop, brass workers' department and boxing department, which previously occupied crowded quarters in the main works.

NEW WATER ELECTRIC POWER PLANT AT DULUTH.—A mammoth water power plant, rivalling that at Sault Ste. Marie, is under way at Duluth, Minn., and it is promised that it will be in operation in about two years. An immense steel gravity dam modeled after that recently completed near Houghton for the Atlantic & Baltic Copper Mining Companies, will be constructed at the head of the rapids on the St. Louis River, and the water will be conserved in a forebay covering one-half square mile. From this a lined canal two and a half miles in length, 62 feet in width and 17 feet deep will carry the water to the brow of a hill and steel pipes will convey it down the slope a mile to the power house, under a working head of 365 feet. From the power house transmission lines will be run to sub-stations at both Duluth and Superior, a distance of 12 to 15 miles. The plans are for an ultimate capacity of 100,000 hp, but the first installment of machinery will be for six units of 5,000 hp each, and the arrangements will be such that additional units of the same size may be added from time to time. Specifications are now being prepared and bids will soon be solicited.

CONTRACTS PENDING FOR ALABAMA PLANT.—Specifications are now being drawn up for the purpose of constructing a plant to generate energy for light and power use in Sheffield and Tuscumbia, Ala. The same plant is intended to furnish water for these places. The power house will contain a boiler equipment of 600 hp. There will be a 450-hp tandem compound condensing engine and also an engine of similar type of 375 hp capacity. The generator to be utilized for lighting purposes will be a 250-kw machine. A 300-kw generator will be employed. The pumping equipment will comprise a triple-expansion engine of 3,000,000 gallons capacity, also a 1,000,000-gallon engine. The contracts will be let by Henry Parsons, Morris Building, New York. L. H. McIntire, at one time general manager of the Savannah (Ga.) street railway system, is consulting engineer in the matter.

ELECTRICAL CONTRACTS CLOSED.—Mr. H. S. Kemp, superintendent of construction of the Standard Electric Company, Norfolk, Va., writes us: We have just closed a contract for two miles extension of a trolley road at Valdosta, Ga. We have closed with the Pell City Mills, Pell City, Ala., contract for wiring of the same and 114 houses with an arc and incandescent circuit through the mill village. Contracts about completed are the Dalton Municipal Light Plant, consisting of power station, 10 miles of arc circuit through the streets to provide current for 75 General Incandescent arc lamps. Also at Camilla, Ga., the installation of the city arc and incandescent system through six miles of streets; and at Greensboro, N. C., about completed, seven miles of trolley road, the entire track laid on six inches slag ballast.

WIRELESS TELEGRAPHY FOR CUBA.—There was a batch of long poles lashed together on the fore deck of the Ward liner Morro Castle when the steamship sailed last week for Cuba. The poles formed part of a consignment of 102 packages shipped by the Marconi Wireless Telegraph Company of America for wireless telegraph stations throughout Cuba. The complete outfit for the equipment of the first of those stations, to be erected at Havana, is now aboard the Morro Castle. The Marconi company has obtained a concession from the Cuban Government.

MORE EQUIPMENT FOR WASHINGTON HOTEL.—Mackenzie & Quarrier, 203 Broadway, New York, have just secured a contract calling for a 12½-in. by 22½-in. by 14-in. side crank engine to be built by the Harrisburg Foundry & Machine Works for installation in the new Willard Hotel, Washington, D. C. The engine will be direct-connected to a 150-kw generator of General Electric manufacture. This will make the fourth Harrisburg engine to be installed in the hotel. The equipment is used for lighting purposes and for operating electric elevators.

PIPING CONTRACT FOR SUBWAY POWER HOUSE.—The Rapid Transit Subway Construction Company, J. Van Vleck, mechanical engineer, has determined on the important contract for steam, water and drip piping, with tanks for the power station on Eleventh Avenue, between Fifty-eighth and Fifty-ninth Streets, New York. The Walworth Manufacturing Company, of Boston, Mass., secured the contract which will represent an expenditure in the vicinity of $400,000.

COAL-HANDLING PLANT FOR BROOKLYN EDISON COMPANY.—The Brooklyn Edison Company has awarded a contract to John A. Mead & Co., whose New York offices are in the Bowling Green Building, for a large coal-handling plant. The plant is to consist of an unloading tower, cable road, McCaslin conveyor and a storage pocket to have a capacity of 3,000 tons of coal. The equipment will be largely operated by electric motive power.

THE SHAWMUT CLAY MANUFACTURING COMPANY, which is building extensive factories at Shawmut, Elk County, Pa., has awarded contract for the power and lighting plant, to the American Supply & Construction Company, contracting engineer, 120 Liberty Street, 800-hp boilers, Corliss engine, electric generator, feed water heater, pumps, piping, belts, etc. Orders for most of the material have been given out.

SOME A. D. GRANGER CO. ORDERS.—The American Type Founders' Company, of Communipaw, N. J., has ordered two Skinner engines through the A. D. Granger Company, White Building, for direct connection to 75-kw generators of C. & C. build. The Granger people have also taken an order for a 120-hp Skinner engine to be installed in the American Power & Construction Company's plant near Ulmer Park.

ELECTRIC HEATING.—M. C. Burt, of Chicago, who was on May 13, 1903, granted a patent on an electric heater, is at work on the organization of a company for the manufacturing of electric heaters under this patent. The heater conductors consist of iron plates, in conjunction with which some wire resistance is also used, and means are provided for artificially circulating the air through the heater.

KELLOGG TELEPHONES FOR HONOLULU.—The Kellogg Switchboard & Supply Company, of Chicago, have contracted to fit out the Alexander Young Hotel, Honolulu, Hawaiian Islands, with a telephone system, including 260 common battery telephones and lamp signal switchboard.

CRANES FOR NEW INGERSOLL-SERGEANT PLANT.—Pawling & Harnischfeger, of Milwaukee, Wis., have secured the contract for the overhead electric traveling cranes to be installed in the new plant to be built by the Ingersoll-Sergeant Drill Company at Phillipsburg, N. J.

FANS FOR EUROPE.—The Dayton Fan & Motor Company, of Dayton, Ohio, has secured a substantial order for desk and ceiling fans for shipment to Europe. The order was placed by the Goudey-McLean Company, of 88 Maiden Lane, New York.

EXPORTS OF ELECTRICAL MATERIALS.—Following are the exports of electrical material and machinery from the port of New York for the week ended January 31: Antwerp—9 pkgs. machinery, $380; 30 pkgs. material, $1,656. British Australia—130 pkgs. machinery, $7,794; 11 pkgsfl material, $292. Bilboa—1 pkg. machinery, $42. British West Indies—131 pkgs. material, $3,055. Brazil—24 pkgs. material, $221. British East Indies—3 pkgs. material, $267; 3 pkgs. machinery, $90. Central America—21 pkgs. material, $247. Cuba—32 pkgs. material, $2,068. China—22 pkgs. material, $713. Chili—61 pkgs. material, $1,993; 7 pkgs. machinery, $1,224. Colombia—34 pkgs. material, $577. Ecuador—3 pkgs. material, $98. Glasgow—37 pkgs. machinery, $4,060. Havre—12 pkgs. material, $325; 20 pkgs. machinery, $350. Japan—8 pkgs. material, $1,491; 12 pkgs. machinery, $12,648; Liverpool—155 pkgs. machinery, $8,424; 30 pkgs. material, $1,244. London—100 pkgs. machinery, $7,734; 172 pkgs. material, $14,027. Leeds—1 pkg. machinery, $50. Mexico—56 pkgs. material, $1,219; 11 pkgs. machinery, $1,849. Manchester—58 pkgs. machinery, $6,849; 3 pkgs. material, $102. New Zealand—8 pkgs. material, $711. Philippine Islands—143 pkgs. material, $2,381. Peru—12 pkgs. material, $473. Stockholm—1 pkg. machinery, $75. Stuttgart—2 pkgs. machinery, $300.

SOME FITCHBURG ENGINE ORDERS.—The Fitchburg (Mass.) Engine Company, through Mr. Edwin H. Ludeman, manager of its New York offices, 39 Cortlandt Street, has secured the contract for the engines which are to be installed in the new Hotel Belmont, now under construction at Forty-second Street and Park Avenue, New York. There will be three medium-speed tandem compound, four-valve engines, each having a capacity of 300 hp, and one 25-hp engine. The larger engines will be direct-connected to Western Electric generators of 200 kw capacity. The fourth engine will be direct-connected to a Western Electric generator of 150 kw capacity. Mr. Ludeman has also taken a contract for a 475-hp, medium-speed tandem compound, four-valve engine to be installed in the shops of the John Stephenson Car Company, at Elizabeth, N. J. This machine will be direct-connected to a General Electric 300-kw generator. Two 300-hp Fitchburg compound engines are to be shipped the Newburgh company's new hat factory in Orange Valley, N. J. These engines will be direct-connected to Stanley alternators of 200 kw capacity.

AN ELECTRIC INTERURBAN RAILWAY 40 miles in length is to be built from Rochester, through Canandaigua, to Geneva, N. Y. The road will be known as the Rochester & Eastern Rapid Railway. The Comstock-Haigh-Walker Company is building and equipping the line, and expects to have it in operation by next July. The following electrical apparatus is being furnished by the Westinghouse Electric & Manufacturing Company, of Pittsburg, and includes two 650-kw, 3-phase, 3,000-alternations, 390-volt, engine-type alternators, which will be arranged for direct connection to cross-compound engines running at 150 r.p.m.; seven 300-kw, 3-phase rotary converters; four 500-kw and nine 200-kw, oil-cooled transformers, arranged for transformation from 390 to 16,500 volts; and two 37½-kw, direct-current, engine-type exciters operating at about 320 r.p.m. The contract also calls for switchboards, high-tension switches and lightning arresters for the main generating station and three substations.

STROMBERG-CARLSON TELEPHONE CONTRACTS.—The Leeds Telephone Company, Illiopolis, Ill., has purchased its apparatus from the Stromberg-Carlson Telephone Company, of Chicago. The Holland Township Telephone Company, Mode, Ill., has purchased a Stromberg-Carlson switchboard, and the Guthrie Telephone Company, of Guthrie, Ill., has also bought its telephones from the Stromberg-Carlson Company. Other sales reported are to the Okaw Telephone Company, of Sadorus, Ill.; the South Prairie Telephone Company, of Sadorus, Ill.; the North West Prairie Telephone Company, of Sadorus, Ill. The White County Union Telephone Company, of Carmi, Ill., has purchased additional equipment for their system from the Stromberg-Carlson Company, and the Mason City Telephone Company, of Mason City, Ill., has also purchased additional Stromberg-Carlson equipment.

UNITED BARIUM COMPANY.—George S. Ettla and Theodore L. Welles have been appointed temporary receivers of the United Barium Company, of Niagara Falls, by an order of the Supreme Court. Mr. Ettla is president of the company and Mr. Welles the superintendent, and they with J. G. Petriken, a director, signed the application for the appointment of a receiver. Augustus Thibaudeau, of Niagara Falls, has been appointed referee, and the first hearing will be on May 16. It is stated in the petition that the company's liabilities are $121,039.48, and that its assets are $91,248.61 and certain interests in patent rights that have a purely speculative and unascertainable value. It is given out by some of the men interested that the company is to be reorganized with an increased capitalization.

TELEPHONE COMPANIES SOLD.—The Maryland Telephone & Telegraph Company, of Baltimore, Md., was sold, on January 30, to a syndicate represented by the Central Trust Company. It is stated that the company's capital will be increased for betterments. The Standard Telephone Company, of Atlanta, Ga., was sold at auction, on February 4, to Robert Alexander, of the law firm of Alexander & McGill, of Philadelphia. The price paid for the company's effects and property was $200,000, which was the upset price fixed by the court. The sale was the result of a foreclosure of a mortgage held against the company by the City Trust Safe Deposit & Surety Company, of Philadelphia.

THE AUTOMATIC EXCHANGE IN CHICAGO.—The Illinois Telephone & Telegraph Company has begun the equipment of its automatic telephone exchange at 181 Fifth Avenue, Chicago. This exchange is quite a contrast to the ordinary telephone exchange building. The automatic apparatus is stored away much after the manner of goods in a warehouse, precautions being taken, of course, to exclude dust. The system is that of the Automatic Electric Company. The company is going to work at once to install instruments, and begin operations in the down-town district of Chicago. The telephones will be paid for entirely on a measured service basis, except that there will be a maximum charge.

WESTINGHOUSE GAS ENGINE ORDER.—Westinghouse, Church, Kerr & Co. have been awarded another contract for gas engines to be installed in the Winchester Repeating Arms Company's plant at New Haven, Conn. The order calls for two 16-in. by 18-in. three-cylinder Westinghouse gas engines, to be operated on the Loomis-Pettibone system of producer gas. These engines will be direct-connected to Westinghouse generators of 100-kw capacity each. The existing New Haven plant consists of three similar Westinghouse engines direct-connected to Westinghouse generators. The plant furnishes current for both light and power purposes.

WESTINGHOUSE COMPANY BUYS BELDEN ARC PATENTS.—The Belden arc lamp patents have been acquired by the Westinghouse Electric & Manufacturing Company. The purchase price was in the vicinity of $50,000. The patents were the property of E. H. Belden, of Dayton, Ohio. The lamps were manufactured by the Dayton Fan & Motor Company. An extensive foreign trade has been carried on for some time past, principally through the Federal Electric Company. The lamps were exported chiefly to India and Australia. They will now be manufactured by the Westinghouse interests.

WIRELESS FOR STEAMSHIPS.—According to a statement given out by the Marconi Company, all the fast steamers of the International Mercantile Marine Company will be equipped with wireless telegraph plants. The recent delay of the St. Louis emphasized the need of such an equipment. Clement A. Griscom, Jr., New York manager of the steamship concern, and John Bottomley, general manager of the Marconi Wireless Telegraph Company of America, have concluded a contract for the St. Louis, St. Paul and New York.

HAMILTON CORLISS ENGINE ORDER.—The Hooven-Owens-Rentschler Company, of Hamilton, Ohio, represented by Mr. W. B. Mayo, 39 Cortlandt Street, has been awarded a substantial contract for engines which will serve as an equipment in the power station of the Washington, Baltimore & Annapolis Street Railway. There will be two cross-compound condensing Hamilton Corliss engines, each having a capacity of 1,500 hp. They will be direct-connected to 1,000-kw generators.

WELSH COAL FOR PORTO RICO.—The San Juan Light & Transit Company, of San Juan, Porto Rico, which was built and is operated by the electrical engineering and contracting firm of J. G. White & Co., 29 Broadway, New York, has just purchased 1,700 tons of Welsh coal for its plant because of the difficulty in filling fuel requirements promptly in the United States.

MEAD MANUFACTURING PLANT FOR CHICAGO.—John A. Mead & Co., Bowling Green Building, New York, are constructing an extensive plant near Grand Crossing, Chicago, to be utilized for the manufacture of their coal-handling specialties. Electricity will be employed to operate the machinery. Three electric traveling cranes are to be installed.

BALL ENGINES.—The Pennsylvania Railroad Company is installing in the new Camden Station four 250-hp cross-compound engines, each direct-connected to Westinghouse alternators. These alternators will run in parallel and the engines are equipped with synchronizing devices. The Ball Engine Company, Erie, Pa., furnishes the engines.

ELECTRIC CARS TO BE BUILT IN MEXICO.—Isaac M. Hutchison, of Mexico City, who represents the Mexican interests of the American Steel Foundry Company and other progressive United States concerns, is about to build an extensive plant in the southern republic for the purpose of constructing electric and other types of cars.

General News.

THE TELEPHONE.

SAN FRANCISCO, CALIF.—The Mission Long Distance Telephone Company, of San Francisco, represented by Gratz K. Brown, has petitioned the Supervisors to offer for sale a 50-year telephone franchise. Among the conditions are a rate of $63 per year for business and $33 for residence telephones; all slot telephones to be prohibited; a limited number of free telephones to the city and the system to be constructed for 18,000 subscribers at the start.

ROME, GA.—Offices will be established at Rome, Ringgold and other points in connection with the long distance line from Atlanta to Chattanooga.

ATLANTA, GA.—The Southern Bell Telephone Company will remove its headquarters from New York to Atlanta early in the spring. A large clerical force and the offices of the auditor and secretary and treasurer are included in the move. The transfer will probably be made in April.

WALLACE, IDAHO.—C. C. Landes, P. F. Smith and others of this place have organized a telephone company.

HARTFORD CITY, IND.—The United Telephone Company will put in a rural telephone system to take in all the surrounding country.

NEW ALBANY, IND.—The Cumberland Telephone Company has extended its lines to Palmyra and Galena and will make further extensions.

ELKHART, IND.—The Paris Mutual Telephone Company has increased its capital stock to $1,000 and will install a number of new telephones.

KOKOMO, IND.—The Citizens' Telephone Company, of this city, has increased its capital from $25,000 to $100,000. Improvements and extensions will be made.

CLARK HILL, IND.—The People's Co-operative Telephone Company has been incorporated with a capital stock of $500. The incorporators are N. J. Bailey, W. E. Bryant and others.

BEDFORD, IND.—The Bedford Telephone Company has re-organized and incorporated with a capital stock of $75,000. The new organization absorbed the Ruddick Telephone Company.

WABASH, IND.—The Wabash Home Telephone Company will issue $20,000 worth of bonds to pay off the debt incurred through the destruction of the exchange by fire a few months ago.

EVANSVILLE, IND.—The municipal telephone project has progressed to the point where the preferred stockholders of the municipal telephone company held a meeting and prepared articles of incorporation.

MUNCIE, IND.—The Madison & Delaware Counties Telephone Company is stringing about 200 miles of copper wire and will install about 250 telephones in the near future. This will give it a total of 1,000 subscribers.

TERRE HAUTE, IND.—The Kinloch Telephone Company, of St. Louis, on Jan. 21 made connection with Terre Haute on its long-distance line which connects St. Louis with the Indiana system of independent exchanges, including Indianapolis.

LAFAYETTE, IND.—The Salem Co-operative Telephone Company has been incorporated to operate telephone exchanges and lines in the Salem neighborhood, Tippecanoe County. W. P. Pierce, F. M. Buskirk and M. F. Jeffers, all of Lafayette, are the incorporators.

RICHMOND, IND.—The Home Telephone Company, of this city, has re-elected its old officers. It has over 1,700 telephones in use. A line will be built into Richmond from the east by the United States Company, and Richmond will be the terminal for Ohio connections.

RILEY, IND.—The Union Telephone Company, of Vigo and Clay counties, has filed articles of incorporation. The headquarters will be in Riley. The company will establish exchanges and lines and operate a system in Vigo and Clay counties. John Schinnierer and Christian Fox are the principal officers.

GREEN CASTLE, IND.—The city council has granted the Putnam County Mutual Telephone Company a franchise to enter the city and establish an exchange. This will result in a dual system to the regret of the citizens. The company is a rural concern and will afford a large number of farmers connection with the city.

BRANCHVILLE, IND.—The Eckerty, Branchville and Connelton Telephone Company has been incorporated and the headquarters will be established at Doolittle Mills, Perry County. The corporation will construct exchanges and operate a co-operate system in Perry and Crawford counties. J. J. Esary, H. T. Lynch and T. H. Frakes, all of Branchville, constitute the directorate.

BICKNELL, IND.—The Bicknell Telephone Company has bought out the Miller interests which originally started the exchange here. The company has incorporated with $6,000 capital, with J. H. Barr, president; W. L. Lemen, vice-president; J. S. Hoover, secretary, and E. D. Miller, manager. At present the company has 110 subscribers with toll line connection throughout the county. Extensions are being planned.

CORYDON, IND.—The Independent Telephone and Telegraph Company, of this city has filed articles of incorporation with a capital stock of $15,000, reserving the right to increase the capital from time to time. The company will establish, construct, maintain and operate telephone exchanges and telephone lines in Harrison, Floyd, Washington, Orange, Crawford and Perry Counties. O. S. Wright and E. D. Mitchel are the principal officers.

CADIZ, IND.—Another telephone line is building from the north into this town—a place of 300 people. The town is now the center for twenty-two co-operative rural telephone lines none of which has less than two dozen subscribers. Besides these there are five long distance lines connecting with the co-operative lines. All Cadiz patrons have free connection with upwards of a thousand telephones over eastern Indiana. The patrons build the lines themselves and get this service for a small amount which goes toward the upkeep of the exchange.

INDIANAPOLIS, IND.—The stockholders of the New Long-distance Telephone Company have formed a voting trust, the purpose of which is to perpetuate the present management, for a period of five years. Ninety-five per cent. of the stock has signed the agreement, which provides that the stock shall be deposited with the Union Trust Company, of Indianapolis, as trustee, which will issue trust certificates to take the place of the stock certificates issued by the company. These trustee certificates are transferable, the same as the stock certificates. The effect of this action is already noticeable, in the stiffening up of the stock on the local market.

GREEN CASTLE, IND.—Over a hundred representatives from warring telephone factions in this (Putnam) County gathered in this city on Jan. 23 for a conference in regard to securing entrance to the city for the various rural telephone interests. The Putnam County Telephone Company, doing business in the southern part of the county made a demand for a franchise for a switchboard in the city, with other privileges. The council deemed such a franchise unjust to the city exchange, which has over six hundred instruments, and the meeting was called by the council in order to secure an agreement between the independent lines and the City Company, relative to the use of the city switchboard as it now exists, by the payment of a rate satisfactory to all concerned. After a heated discussion, a committee was appointed to represent the independent companies in a conference with the company's managers. This committee met the City Company with a proposition that the independent companies agree to one of three things: To build a double line to the city limits, one a single line and the other a metallic circuit, the single line to be used by every telephone holder on it free of cost; the telephone holder to pay a flat rate of 5 cents over the existing lines into the city, or to pay a rate of 25 cents a month, with the privilege of talking all they want to. A resolution was adopted rejecting the three propositions submitted to them by the city company, which were in the nature of a compromise with the country system. The failure of a peaceful settlement is very much regretted. As the matter now stands the city is threatened with a dual system.

LEMARS, IA.—An election will be held on February 16, to vote on the question of granting a telephone franchise to the Lemars Telephone Company.

BLAINE, IA.—The Farmers' Mutual Telephone Company has been incorporated with a capital stock of $3,000 by F. Evans, L. W. Hiatt, J. I. Knox and others.

WATERLOO, IOWA.—During the latter part of January the Commonwealth Telephone Company was organized with headquarters at Waterloo, Iowa, and secured control of the following telephone properties in that State: Cedar Valley Telephone Company, The County Telephone & Telegraph Company, The Waverly Telephone System, The Hardin County Telephone System, The Parkersburg Telephone System, and The La Porte City Telephone System. The new company is capitalized at $900,000 and will operate in eight Iowa counties. The apparatus, made by the Automatic Electric Company, Chicago, will be installed in Waterloo, and other towns where the company operates.

PORTLAND, ME.—The International Telephone & Telegraph Company has been incorporated with a capital stock of $1,000,000. Mr. R. R. Gilman is president.

MONROE, MICH.—The Home Telephone Company, of Monroe, is to be incorporated in the near future and the promoters are planning to install the Strowger automatic system.

LANSING, MICH.—The Citizens' Telephone Company has announced an increase in rates for residence telephones of $12 to $18. Telephones now in use will continue to be charged at the old rates.

GREAT FALLS, MONT.—The Rocky Mountain Bell Telephone Company has secured an option on the Choteau-Farmington line near here.

GENEVA CITY, NEB.—A franchise has been granted to John Barsby to establish a telephone exchange in this place.

WILSON, N. C.—The American Telephone Company will open an office in Wilson, N. C., for long distance service.

COLUMBUS, N. C.—At Columbus the Polk County Telephone Company is preparing to build a line to Lynn. A long distance line has been built between Jonesboro, Sanford and Carthage, N. C., and one from Lexington, N. C., to Yadkin College.

GALLIPOLIS, OHIO.—A company is being formed here to build a telephone line from Lecta to Clay Lick.

AKRON, OHIO.—The Akron People's Telephone Company will lay conduits in the business section of the city.

MIDDLEFIELD, OHIO.—W. E. Hutchis, H. C. Gross and E. E. Newman, of Hamilton, will install an exchange at Middlefield.

CLEVELAND, OHIO.—The United States Telephone Company is preparing to string a new long distance circuit from Cleveland to Toledo.

RICHWOOD, OHIO.—The Richwood Telephone Company has increased its capital stock from $10,000 to $20,000, and will make improvements.

HAMILTON, OHIO.—The Camden Telephone Company will extend its lines to the surrounding towns. Some of the material has already been ordered.

BLOOMDALE, OHIO.—The council has granted a franchise to Claud Wygandt, of Toledo, to maintain and operate a telephone exchange in this place.

MANSFIELD, OHIO.—R. M. Brown and S. M. Lanz, of Franklin, have formed a telephone company and will build a farmers' system in that district.

MARTIN'S FERRY, OHIO.—The Belmont Telephone Company is planning to extend a farmers' system through Mt. Pleasant. A. W. Riddle is active in the enterprise.

CARROLLTON, OHIO.—The Kilgore Telephone Company, of Kilgore, will build a line from that place to Amsterdam. The company has connections with the Bell lines at the latter place.

WAKEMAN, OHIO.—The Norwalk Telephone Company has purchased the local telephone company's line from New London to Berlin Heights, by way of Clarksfield, Wakeman and Florence.

PARKMAN, OHIO.—The Parkman Telephone Company, recently organized, is preparing to install its system. The company will furnish service throughout the farming district at $12 per year.

WEST UNION, OHIO.—William Hiller, of the Ohio Telephone Company, Georgetown, is planning to build connecting lines to West Union, Blue Creek, Wamsleyville, Otway and Mineral Springs.

MIDDLEPORT, OHIO.—The Middleport Telephone Company will build a line from Middleport to Kyger. W. E. Russell is president and John Brechtel, superintendent of construction for the company.

HILLSBORO, OHIO.—The annual meeting of the Hillsboro Telephone Company indicates that the company is in a prosperous condition. It has 360 telephones in use and will install more this spring.

ATHENS, OHIO.—The Athens County Telephone Company has added another 100-line switchboard and night service has been instituted. The company is planning to extend lines throughout the farming districts.

WARREN, OHIO.—The Jefferson & Warren Telephone Company has increased its capital stock from $60,000 to $80,000. It will make numerous extensions in the territory surrounding Warren and Jefferson.

BURTON, OHIO.—The farmers' telephone system has been completed to Marshalltown and is being extended to Wadsworth and Barberton. The farmers' system in this district is said to be the most complete in the country.

LIMA, OHIO.—The Lima Telephone Company has installed an addition to its switchboard and is prepared to take care of 400 additional subscribers. The company is extending its farmers' system throughout the county.

NORWALK, OHIO.—The Norwalk Telephone Company has engaged L. W. Stanton, the Cleveland engineer, to design a new switchboard and other office equipment. The new apparatus will be installed as soon as possible.

NORTH BALTIMORE, OHIO.—The North Baltimore Telephone Company has been incorporated in West Virginia. Capital $2,000. Incorporators: C. B. Blose, F. M. Dotson, Samuel Wyant and C. F. Miles, of Toledo.

YOUNGSTOWN, OHIO.—The American Telephone & Telegraph Company has completed plans for the installation of five additional toll circuits between Youngstown and Pittsburg. The service between the two cities has been very heavy.

HAMILTON, OHIO.—The Hamilton Home Telephone Company will shortly open its exchange in this place. It is planning to extend the service throughout the county. Frank Hughes is president and J. W. Sloneker, secretary of the company.

AKRON, OHIO.—The Akron People's Telephone Company will build toll lines of its own to Canton and Massillon. At present the company uses the United States Company's lines, but these are so crowded that the service is unsatisfactory.

PROSPECT, OHIO.—The probate court has granted a franchise in Prospect to the Marion County Telephone Company. The company has been desirous for some time of extending its service, but the town has repeatedly refused a franchise grant.

BELMONT, OHIO.—The Belmont Telephone Company has elected new directors as follows: J. C. Dent, L. B. Driggs, H. Schumlbach, J. W. Doud, E. G. Smith and others. The company will make extensive improvements during the coming year.

DELAWARE, OHIO.—The Citizens' Telephone Company has increased its capital stock from $60,000 to $100,000 and is planning important extensions throughout its territory. W. M. Heseltine is president, and G. H. Carter, secretary of the company.

MARIETTA, OHIO.—The Muskingum Valley Telephone Company has recently incorporated with $5,000, and will build lines from Swift Station to Marietta, by way of Lowell and Beverly. E. B. Vincent is president and W. W. Mason, general manager.

BELLEVUE, OHIO.—The Local Telephone Company will soon close contracts for the installation of a multi-switchboard with party line service for the Norwalk exchange. LeRoy W. Stanton, consulting engineer, Cleveland, has prepared plans for the exchange.

NEW PHILADELPHIA, OHIO.—The Tuscarawas County Telephone Company has elected these directors: P. B. Scott, president; E. A. Walter, secretary; J. L. Kennedy, treasurer; E. P. Scott, E. Weibensen, N. I. Dreyfoos, W. M. Tracey and C. D. Juvenal.

RAVENNA, OHIO.—The Portage County Telephone Company is planning to extend its system throughout Rootstown, Randolph, Deerfield, Edinburg, Atwater, and Palmyra townships. A large amount of money will be spent in extending the service throughout the county.

NORWALK, OHIO.—The Norwalk Business Men's Association has agreed not to pay the advance in price asked by the Central Union Telephone Company in this city. All of the association members will order their telephones taken out if the company persists in its demands.

KENT, OHIO.—The newly organized Portage County Telephone Company will issue $100,000 bonds to make improvements. The company has over 1,500 subscribers in the various exchanges recently consolidated. A large amount of construction work will be done this summer.

UTICA, OHIO.—The Utica & Homer Telephone Company has been incorporated, with $40,000 capital stock, to construct telephone lines throughout Licking County, with exchanges at Homer and Utica. D. E. Sapp, Frank L. Beam, W. C. Sapp, R. M. Greer, H. C. Devin are interested.

PLAIN CITY, OHIO.—The Plain City Home Telephone Company now has 343 telephones, a gain of 125 within a year. The company operates over 600 miles of toll line in Madison and Union counties and is preparing to build considerable additional mileage of lines. C. Leggett is manager.

ELYRIA, OHIO.—T. M. Brush and I. H. Griswold, of Elyria, have purchased from Barber & Brailey, of Wauseon, a large interest in the Rome Home Telephone Company, of Rome, N. Y. The property will be connected with the other independent exchanges operated by the Rawson-Brush syndicate, of Elyria.

TIFFIN, OHIO.—The Tiffin Home Telephone Company has elected the following named officers: Ed. L. Barber, president; A. L. Flack, vice-president; E. B. Myers, treasurer and K. F. Briggs, secretary. The above with E. R. Strohm, are directors. The company is planning a number of extensions throughout its district.

MARYSVILLE, OHIO.—The Marysville Telephone Company has 350 subscribers, an increase of 100 during the past year. The company has a large waiting list and will install a number of new telephones as soon as the material can be obtained. It is also putting up a large number of farmers' lines. Mr. N. E. Leggett is manager.

CLEVELAND, OHIO.—The Federal Telephone Company has arranged to sell to Eastern bankers a large block of the bonds of the United States Telephone Company. The United States property is now earning 3 per cent. in excess of its bond interest and with contemplated extensions it will be earning 5 per cent. before the close of the year.

WAPAKONETA, OHIO.—The Shaffer Construction Company, of Texas, which is building a number of telephone exchanges in Ennis County, Texas, held its annual meeting here recently. C. D. Crites and Walter Riche, of Lima, S. A. VanOss, of Minister, George B. Whitney, of Marysville, and a number of parties in this city are interested in the company.

CLEVELAND, OHIO.—The committee representing the larger Cleveland banks have declined to agree to the proposition made by President Dickson, of the Cuyahoga Telephone Company, to authorize an issue of $2,000,000 preferred stock in order to clear up the floating debts of the company. It is announced that another plan of refinancing the company will be submitted in the near future.

CLEVELAND, OHIO.—Several hundred people have threatened to sue the Cleveland Telephone Company (Bell) for failure to carry out its agreement to install a one way party line telephone for six months' trial for $1. The company took a large number of subscriptions for the new service, but ran out of instruments, and only took care of a portion of those that had paid for the service.

CINCINNATI, OHIO.—The City & Surburban Telegraph Association (Bell) is preparing plans for a large central telephone exchange, to relieve the present Vine Street exchange, which is too small. The new exchange will have a 9,000-line board and will be installed in a three-story exchange building which will cost $150,000. The company is just completing branch exchanges at Norwood, Cumminsville and East End.

LONDON, OHIO.—The West Jefferson Telephone Company, with 100 subscribers, the Charleston Telephone Company, with 200 subscribers, and the London Telephone Company, with 700 subscribers, will soon be consolidated under the title of the Madison & Clark Telephone Company with headquarters in London. The new company will build a large number of farmers' lines and will put in considerable new cable.

CLEVELAND, OHIO.—The Columbiana County Telephone Company has elected these officers: F. S. Dickson, president; Maxime Reber, vice-president; R. F. Judd, treasurer, and W. F. Crossley, manager and secretary. These with W. L. Carey, J. B. Hoge, Will Marron and W. D. McKeefry are directors. The company operates thirteen exchanges and has 2600 telephone in operation. The company will spend about $20,000 in improvements during the coming year.

AKRON, OHIO.—The Akron People's Telephone Company is planning to absorb the independent telephone exchanges in Portage County. These include the Kent Telephone Company with 600 subscribers, the Ravenna Telephone Company with 600, and the exchanges at Mantua and Garrettsville, which have about 200 subscribers each. The Akron company has 3,500 subscribers with exchanges in Akron, Barberton and Cuyahoga Falls. Will Christy is president, and W. F. Laubach, general manager of the company.

CLEVELAND, OHIO.—The Rawson-Brush telephone syndicate, of Elyria, and the Consolidated Telephone Company, of Buffalo, which is largely controlled by Cleveland people, are perfecting an agreement whereby the territory of New York State will be divided up and traffic arrangements made whereby the two syndicates may work in harmony. This will result in the doing away with the duplication of many telephone lines and will tend to improve the service in the Empire State. Heretofore the two syndicates have been in competition for territory.

CHESTERFIELD, S. C.—The local telephone company at Chesterfield has under construction and in contemplation several new telephone lines.

NEWBERRY, S. C.—The town council of Newberry has granted an unlimited franchise to the Bell Telephone Company. It is understood that work will be started at once taking out the old telephones and putting in a new system complete.

MARSHALL, TEX.—F. M. Marriott, J. B. King and P. J. Eubanks have been granted a telephone franchise by the city council.

WACO, TEX.—Ed N. Stephenson and other stockholders in the Electric Construction Company, have brought a suit against the Texas Telephone Company, the Electric Construction Company, and the St. Louis Trust Company. They ask judgment for $60,000 due them, they allege, as purchase money for the telephone exchange, and that an issue of $150,000 of bonds of the Texas Telephone Company be canceled. The plaintiffs also pray for a decree putting both the telephone company and the construction company into the hands of receivers, and that the affairs of the construction company be wound up. The St. Louis defendant is sued as custodian of part of the bond issue sought to be canceled.

RICHMOND, VA.—The Board of Aldermen of Richmond has adopted the ordinance providing for a merger of the Richmond Telephone Company and the Bell Company. The matter will have to go before the common council.

URUGUAY.—The Uruguay Government has approved the statutes of La Economica Telephone Company represented by Senhors A. C. Mendez and M. J. Perez, of Montevideo.

ELECTRIC LIGHT AND POWER.

LOS ANGELES, CALIF.—The new generating station of the Edison Electric Company, situated on Mill Creek in San Bernardino County, is rapidly nearing completion. It is known as power plant No. 3. Its capacity will be 4000-hp. There is a 1960-foot head, with a pressure of 863 lbs. to the square inch. The company has just installed one 3-phase General Electric alternator.

LOS ANGELES, CALIF.—The Edison Electric Company has decided to erect a sub-station at the corner of Main and Fourth Streets. For the present the structure will be two stories high, although the foundation is to be substantial enough to support six stories, as the company will need a larger building in the future for offices and power uses.

SAN LUIS OBISPO, CALIF.—The San Luis Obispo Light, Heat and Power Company has re-incorporated as the Pacific Coast Light, Heat and Power Company; capital stock, $500,000; paid up, $150,000. The reason for the change is to enable the company to extend its business to neighboring counties. William V. Miller, of Bakersfield, and E. S. Hoyt, of this city, are the principal stockholders.

CHICAGO, ILL.—By a unanimous vote the City Council has placed itself on record as desiring municipal ownership and operation of gas and electric lighting plants. The Legislature will be memorialized to pass an enabling act at once.

EAST ST. LOUIS, ILL.—The officials of the Interstate Transit Company, the owners of the automobile line, are circulating petitions about East St. Louis, preparatory to asking the City Council for a franchise for permission to establish an electric light plant in the city. It is promised that the rates will be made considerably lower than those now in force. The East St. Louis Electric Light Company is owned by the East St. Louis and Suburban Railroad.

WABASH, IND.—A movement is on foot to buy the Wabash electric light plant for the city. The council has been petitioned to buy it and make it a municipal plant. The contract with the company expires in a few months.

BOSTON, MASS.—The Old Orchard Electric Light Company has voted to increase the amount of its capital stock to $100,000.

SPRINGFIELD, MASS.—The efficiency of the municipal electric light plant has been greatly increased by the recent addition of a new dynamo and engine, The old dynamo was greatly overloaded. This year it is hoped to add another new dynamo for the street lighting circuit.

GRAND RAPIDS, MICH.—The Grand Rapids Edison Company has decided to equip an extensive power plant for generating purposes on the Flat River above Lowell.

CRYSTAL FALLS, MICH.—The Westinghouse Electric & Mfg. Co. has secured the contract for one 150-kw single-phase and one 90-kw generator for the electric light plant.

DETROIT, MICH.—The Lapeer Light & Power Company has been formed with $75,000 capital stock and has absorbed the lighting plants at Lapeer, Imlay City, Millville and Higley. J. Schlegel is president and Henry Schlegel, secretary-treasurer of the company.

GRAND RAPIDS, MICH.—J. H. Mitchell, Sol P. Kineon and W. H. Settle are promoters of a new electric light and power company that will operate here. They have petitioned the council for a franchise to furnish electricity for light and power, steam and hot water for heating and cold water for refrigerating purposes.

MARQUETTE, MICH.—The new sand wheel house of the Calumet & Hecla Company, which has been in progress of construction since 1901, is completed. Some months will be required to complete the installation of the great wheel. The electrical power house which will operate the apparatus is now being equipped. The American Bridge Company erected the wheel house.

ST. CHARLES, MO.—At the annual meeting of the stockholders of the St. Charles Light and Fuel Company the old board of directors and officers were re-elected. The officers are Edward Gut, president; A. Ross, of St. Louis, secretary, and L. O. Fulkerson, manager.

HEMPSTEAD, N. Y.—The sale of the lighting plant at Hempstead, L. I., to a Philadelphia syndicate, is reported by W. M. Ostrander, of Philadelphia. It was through the efforts of Mr. Ostrander that the plant at Hollidaysburg, Pa., was recently sold.

HICKORY, N. C.—The Thornton Electric Light Company, of Hickory, has been chartered with a capital stock of $8,000.

GREENSBORO, N. C.—The Greensboro Electric Company has been granted a franchise to build a gas plant in Greensboro.

OXFORD, OHIO.—It has been decided to offer the village lighting and water plant to a private corporation. Under municipal management it has been a failure.

WILMINGTON, OHIO.—The United Water & Light Company has been incorporated under New Jersey laws. It has $200,000 capital stock, and will erect a plant here.

ZANESVILLE, OHIO.—The Zanesville Railway, Light & Power Company has broken ground for its new power station. The plant will have a capacity six times that of the present station.

LANCASTER, OHIO.—The Godman Shoe Company will erect a power plant to supply light and power to several factories in this town. Contracts are being placed for engines and generators.

SPRINGFIELD, OHIO.—The Citizens' Light, Heat & Power Company, capital $10,000, has been incorporated by W. L. Weaver, W. W. Keifer, F. M. Hogan, W. P. McColloch and A. M. Kunker.

ROCK HILL, S. C.—It is reported that the plant of the Rock Hill Water, Light and Power Company has been sold to Geo. MacDonald, of New York City, and others for approximately $70,000.

ABERDEEN, S. D.—The City Council is stated to have granted a franchise to the Aberdeen Gas Company. The company will install a gas and electric light plant.

TRENTON, TENN.—A movement is on foot at Trenton for the purchase by the city of the local lighting plant for $6,000. Bonds may be issued for the purpose.

NASHVILLE, TENN.—Michigan purchasers of the Caney Fork Falls water power, 12 miles east of Minnville, will erect a $1,000,000 power house and dam, with a capacity to transmit power to Nashville. The enterprise is said to have ample funds behind it.

KELSO, WASH.—The Metcalf Shingle Company is reported to have submitted a proposition to the city to install an electric light plant.

MONTICELLO, WIS.—The village council is stated to have granted J. H. Staedtler a franchise for an electric light plant.

WINNIPEG, MAN.—The big electrical works of the Winnipeg General Power Company, on the Winnipeg river near Lac Du Bonnet, are now in course of construction. This company has commenced operations with a large force of men, and Winnipeg is now within measurable distance of obtaining electrical power by transmission over a distance of about 55 miles, which is the distance between the city and the works.

CITY OF MEXICO, MEX.—The Mexican Gas and Electric Light Company, of the City of Mexico, is negotiating with the municipal council of that city for a contract to establish an extensive telephone service there.

TAMPICO, MEX.—A new electric light company has been formed in the city of Tampico, Mexico. The capital of the concern is $200,000. It will, however, be fully twelve months before the plant it proposes to erect will be in running order. In the meantime the present owners of the plant now in operation are perfecting plans whereby the works are to be considerably enlarged. The equipment will be purchased in the United States.

THE ELECTRIC RAILWAY.

GENEVA, OHIO.—Frank Hood, of Ashtabula, has been granted a county franchise to build an electric railway from Geneva to the lake shore.

YOUNGSTOWN, OHIO.—Local people are planning to build an electric railway from the city to the new plant of the National Steel Company.

RICHMOND, VA.—The Virginia Passenger & Power Company, of Richmond, intends to rehabilitate the Seven Pines electric railway to that famous battlefield.

TOLEDO, OHIO.—The Interurban Construction Company has been incorporated, with $10,000 capital stock, by H. R. Klauser, A. E. Klauser, N. Schmidt, J. H. Pheat and H. F. Shunck.

MARTIN'S FERRY, OHIO.—The Wheeling Traction Company has asked for a franchise in Martin's Ferry and as soon as the grant can be obtained a line will be built from Martin's Ferry to Brilliant.

TOLEDO, OHIO.—The Toledo & Western Railway Company has re-elected the present directors, i. e., Hon. Luther Allen, Judge C. M. Stone, J. R. Seagrave, W. L. Hayes and E. B. Allen, Cleveland, and F. E. Seagrave and C. E. French, Toledo.

MONTPELIER, OHIO.—M. C. Peterson and George M. Clarken, of Ann Arbor, are securing right of way for the projected Hillsdale-Bryan railway. The road will be about 40 miles in length and it will be financed by Detroit and Ann Arbor people.

SANDUSKY, OHIO.—The Sandusky Southwestern Railway Company has elected these officers: John VanFleet, president; F. C. Olsen, vice-president and general manager; S. P. Douglass, secretary; S. W. McFarland, treasurer; W. H. Wyke, superintendent.

CLEVELAND, OHIO.—The Cleveland, Richfield & Akron Transit Company has been incorporated, with $10,000 capital stock, by Daniel Gindelsperger, S. P. Inman, J. R. Zmut, R. J. Wood and Fred W. Green. The company has been working for some time on a line between Cleveland and Akron.

FOSTORIA, OHIO.—The Toledo, Fostoria & Findlay Railway Company has elected these officers: J. E. Reeves, president; E. C. Deardorff, vice-president; Theodore Wentz, secretary and general manager, and A. J. Krantz, treasurer. The above with S. W. Croxton, S. W. Adams, E. A. Wentz, and J. D. McDonald are directors.

CLEVELAND, OHIO.—At the annual meeting of the Cleveland Electric Railway Company the following named directors were re-elected: Horace E. Andrews, R. A. Harman, J. J. Stanley, James Parmelee, Myron T. Herrick, Clavary Morris and C. L. Pack. Several additional storage batteries will be installed in various parts of the city.

NEW PHILADELPHIA, OHIO.—The Tuscarawas Traction Company has elected these officers: F. T. Pomeroy, Cleveland, president; J. A. Rutherford, Cleveland, vice-president; J. O. Wilson, Cleveland, secretary; Will Aikins, trasurer and general manager. The above with Theodore Wentz, George Bowers and Will Christy are directors.

CLEVELAND, OHIO.—The Cleveland City Railway Company held its annual meeting and elected these officers: M. A. Hanna, president; C. F. Emery, vice-president; John Ehrhardt, secretary-treasurer; George G. Mulhern, superintendent; W. C. Phelps, purchasing agent; E. J. Cook, chief engineer. Directors: Mark Hanna, C. F. Emery, George Mulhern, L. W. Prior, W. B. Sanders, H. E. Andrews, R. R. Rhodes, J. H. Wade and C. A. Otis, Jr.

DETROIT, MICH.—At the annual meeting of stockholders of the Detroit United Railway the following officers and directors were re-elected: H. A. Everett, chairman of board; J. C. Hutchins, president and general manager; Arthur Pack, vice-president; George H. Russel, treasurer; Edwin Henderson, secretary, and A. E. Peters assistant secretary. Directors: H. A. Everett, E. W. Moore, H. R. Newcomb, R. A. Harman and George H. Russel, Cleveland; J. C. Hutchins and Arthur Pack, Detroit; R. B. VanCourtlandt, New York, and H. S. Holt, Montreal.

PERSONAL.

PRES. A. C. HUMPHREYS.

PRES. ALEX. C. HUMPHREYS was duly inaugurated last week at the Stevens Institute of Technology, Hoboken, N. J., succeeding the late Prof. Morton. The exercises on Thursday afternoon, February 5, at the Institute were followed by a brilliant banquet at Sherry's in the evening. Alexander Crombie Humphreys came with his parents to America when he was eight years of age. He was born March 30th, 1851, in Edinburgh, Scotland, of English and Canadian descent, his father, E. R., Humphreys LL.D., being a well-known educator. The family took up its residence in Boston, where the boy attended school and later, receiving an appointment to the United States Naval Academy, successfully passed a special test examination. It was then discovered that he was less than sixteen years old, and was on that account rejected. He therefore entered upon a business career, intending at the proper age again to apply at the Naval Academy. Fortunately his keen interest became aroused in other matters. His first business experience was in a Boston insurance office. In 1866 he came to New York and remained with the Guarantee and Indemnity Company until 1872. In that year he was appointed as secretary of the Bayonne and Greenville Gas Light Company, of Bayonne, N. J., with charge of its business interests, and the following year was given full charge as superintendent. Thus began what has been his life work in the line of gas works engineering. Desirous of adding to his acquirements in practice the training of a technical school, he obtained from the company's directorate permission to absent himself two mornings of each week to attend the lectures at the Stevens Institute of Technology. Night and day he labored and, entering the school in 1877, he was graduated in 1881, having devoted to his studies only such time as he could spare from business during the four years. So unusual and so praiseworthy was this that resolutions of commendation and congratulation were adopted by the Faculty of the school on June 11th, 1881, this probably being an act unprecedented in the history of education. In the year of his graduation he became chief engineer of the Pintsch Lighting Company, and thereafter erected many gas plants, conducted experimental work, and gained knowledge of railroad car equipment. In 1885 he accepted the position of Superintendent of Construction of the United Gas Improvement Company, of Philadelphia, and shortly thereafter was made its general superintendent. He has been the chief executive officer of more than 50 gas and electric light companies, and was for a time president of the Syracuse Gas Co., Syracuse, N. Y., vice-president of the United Coke and Gas Company, Philadelphia, Pittsburgh and New York, and president of the City Gas Company, of Norfolk, Va. He is now president of the Buffalo Gas Company, Buffalo, N. Y., and president of the Hibbard-Rodman-Ely Safe Company, of New York. He is a member of the American Association for the Advancement of Science and of the leading engineering societies, and was president of the American Gas Light Association for the year 1898-1899. He has been a frequent contributor to technical literature.

MR. F. J. GUERNSEY succeeds E. W. Richey as superintendent of the Union Elevated Loop in Chicago.

MR. E. W. RICHEY, superintendent of the Union Elevated Loop in Chicago, has resigned to take a position with the Illinois Steel Company.

MR. ROBERT DOBLE, consulting and supervising engineer, of San Francisco, has removed his offices from the Hayward Building in that city to 417 Rialto Building.

MR. H. W. TOMLINSON, recently appointed assistant purchasing agent for the Chase Electric Company, 26 Cortlandt Street, was killed in the recent Westfield, N. J., railroad disaster.

MR. GANO S. DUNN, chief engineer of the Crocker-Wheeler Company, is seeking respite from grippe and hard work in the sunny clime and on the hospitable shores of Jamaica, West Indies.

MR. W. H. CUMMINGS, formerly manager of the British electrical engineering and contracting firm of Maguire & Baucus, London, has sailed for Europe after several weeks' visit on this side.

MR. WILLIAM F. SINGER is now New York manager of Fairbanks, Morse & Co. at 133 Liberty Street, pushing their well-known types of motors, etc. Mr. Singer formerly had charge of the Indianapolis office.

MR. L. W. STANTON, the consulting telephone engineer of Cleveland, Ohio, has recently been very busy on several plants in the Central States, but was in New York last week, when he participated in the Institute's annual dinner.

VICE-PRESIDENT VANDERGRIFT, of the Vandergrift Construction Company, Philadelphia, has gone to Porto Rico in connection with the proposed electric traction system to be constructed between San Juan and Ponce, a distance of about 70 miles.

MR. T. M. ELLIS.—The Rockford, Ill., Morning Star, of Feb. 1 has an interesting account of the history of street railways in Rockford, leading up to the present Rockford & Interurban Railway. The article includes a portrait of general manager T. M. Ellis.

MR. H. WRAY WELLER, C. E., Canadian representative of the Babcock-Wilcox boiler interests and an old Sprague and General Electric man, has been visiting New York from Montreal. He attended the Institute dinner last Monday and has followed up several matters of engineering interest.

DR. W. M. HABIRSHAW, of the India Rubber & Gutta Percha Insulating Company, is starting on a well-earned vacation this week, and sails for Cuba. He expects to be gone about six weeks and will see a good deal of the West Indies in the time, devoting the period named entirely to rest and recreation.

MR. THOMAS CASEY, at one time superintendent of J. H. Bunnell and Company, latterly superintendent of the Bunnell Telegraph & Electric Company, and who more recently acted in a similar capacity for consolidated Bunnell interests, has been appointed superintendent of the Manhattan Electric Supply Company's works at Jersey City.

MR. LOUIS A. FERGUSON, president of the National Electric Light Association, has been in New York during the past week organizing new work and arranging for the programme of the next convention. The annual meetings of the Association have reached so high a standard that the members and the public have come to expect a very attractive programme.

MR. CHARLES D. SEEBERGER, the originator of the escalator system, sailed for Europe on the *Oceanic* on February 11. Mr. Seeberger went abroad to complete arrangements for installing escalators in the stations of the new London underground railroad, the preliminary negotiations having been conducted by the Waygood-Otis Company of that city.

MR. ALLAN V. GARRATT, chief engineer of the Lombard Governor Company, of Boston, was in New York last week and reported the outlook for hydro-electric developments as splendid. Some idea of the closer regulation of dynamo turbines now effected may be formed from the fact that in the vicinity of Montreal alone 40 Lombard governors are in use. Mr. Garratt has returned recently from a Southern trip.

MR. W. JONES, a leading merchant of Tacoma, Wash., and president of its chamber of commerce, when in New York last week said: "There are within a radius of 12 miles of Tacoma, 70,000 horse-power—a great deal already developed, and the remainder in course of development. So that, with coal a few miles off, and slab wood from the numerous mills for the cost of hauling, the large electric plants can quote rates that preclude the feasibility of anything but electricity being used."

MR. RAMON VALDES, whose offices are in the Edison Building, 44 Broad Street, New York, has sailed for Porto Rico, in connection with the interests of the Rio Plata Electric Company, which concern proposes to construct a dam and power house on the Rio Plata, located in the mountains about 17 miles distant from the city of San Juan and which also contemplates the conversion of the existing narrow gauge steam road running between Catano and Bayemon, a distance of about four and one-third miles, into a broad gauge electric traction system. Mr. Valdes expects to be absent about a month.

MR. FRANK A. BURRELLE has just delivered to the Postal Telegraph Company the 20 albums containing the published obituaries of the late John W. Mackay. The labor of gathering and placing in album form was begun last July. There are 5,480 clippings to each set covering 1,536 pages of Irish linen leaves 10x12 inches. This is the largest collection of material ever gathered concerning the death of a private individual, and the kindly expression of the press of the country was unanimous. Four sets of books were ordered by the Postal Company, one set being designed for Mrs. Mackay, the second for Mr. Clarence Mackay, one for the Postal Telegraph Company and one for the Commercial Cable Company.

MR. ARTHUR WILLIAMS, who has been appointed by President Ferguson to report on decorative lighting at the coming convention of the National Electric Light Association, has sent out a letter to all the active members, asking them to send him illustrations of the different designs of display lighting installed by them. Mr. Williams will have half-tone engravings made of these designs and will have them printed in connection with his report. From replies already received there seems to be widespread interest taken in this attractive and profitable department of electric lighting, and the very complete report to be presented by Mr. Williams will add greatly to the value of the programme of the convention.

MR. GEO. GRAY WARD.—Commercial Cable officials are trying to set the world on fire as well as cable it. Lately it was Mr. Chandler, now it is Mr. Ward. Last week some one saw sparks coming from the chimney of Mr. Ward's house at 51 West Fifty-third Street and called the engines. Engine 65, going up Sixth Avenue to the fire, ran into a truck, knocking off the driver, John Carroll, of 74 Carmine Street, and a helper. Carroll's leg was broken. Mr. E. Rollins Morse came up in an automobile and lent a lamp from his machine to the ambulance surgeon who was dressing Carroll's leg. Carroll was taken to the Flower Hospital. There was a little soot afire in Mr. Ward's chimney. A scuttle of coal dumped down the chimney ended the trouble. The funny thing is that Mr. Ward is manager of the Commercial Cable Co. while Mr. Morse is at the head of the Marconi wireless enterprise in this country.

MR. J. R. BIBBINS, of the Westinghouse Companies' Publishing Department, New York City, delivered an interesting and comprehensive address at the last annual banquet of the New York Physics Club upon the subject of "Recent Developments and Use of Electric Power." The address closely followed the subjective topics of systems and appliances, power development, high tension transmission, and electric traction, and briefly treated of the conditions leading up to and the present trend of modern engineering practice in the field of power utilization. Late inventions were also touched upon in the address, prominent among them being the Hewitt vapor lamp and converter and recent single phase traction systems. Mr. Bibbins' address formed the closing number of an excellent programme of short addresses by guests of the Club upon questions pertaining to proper methods of education in physical science. The list of speakers included District Supt. D. H. Bardwell, Prof. C. R. Richards, of Teachers' College, Director Arthur L. Williston, of Pratt Institute, Dr. Julius Sachs, and Dr. Walter B. Gunnison. The banquet was held at the Chelsea, West 23rd St., with excellent attendance. Pres. J. M. Jameson, of the Pratt Institute, Brooklyn, occupied the chair.

Trade Notes.

OIL FILTERS.—An important shipment of oil filters and exhaust heads was recently made by the Burt Manufacturing Company, of Akron, O., to its agency at London, England. Other export orders went to Sweden, Japan and Argentine Republic.

BULLOCK CALENDAR.—John Tyndall, the distinguished English scientist, is the subject of the biographical sketch on the Bullock calendar for February. A colored portrait of Tyndall heads the card, the coloring of which is very pleasing.

SPENCER, TRASK & CO., 27-29 Pine Street, New York City, have issued for 1903 another edition of their excellent Statistical Tables relative to securities quoted on the New York Stock Exchange. It is a most handy and compendious little book.

THE WARREN ELECTRIC & SPECIALTY COMPANY, Warren, Ohio, has bought the old co-operative bicycle factory at St. Catherines, Ontario, and will equip it for the manufacture of incandescent lamps, with a view to supplying the Canadian trade.

THE HALL ELECTRICAL SUPPLY COMPANY, 213 West Fourth Street, Cincinnati, Ohio, got out a very neat calendar for this year. The card contains a colored print of a working boy balancing his cash account on the wall. The title of the picture is "A Penny Saved is a Penny Earned."

THE ELECTRIC APPLIANCE COMPANY, Chicago, Ill., carries the largest stock of circular loom conduit in the West. The stock is well assorted in all sizes, from one-quarter inch to two and one-quarter inches inside diameter. The ability to ship directly from stock saves valuable time in delivery.

INCREASED CUTTING SPEEDS.—Flyer No. 50 of the Crocker-Wheeler Company, Ampere, N. J., is devoted to a consideration of the subject of increased cutting speeds. The information given is valuable to machinists and shopworkers, and it is pointed out that the best results in machine practice are secured by electric speed control.

THE GREGORY ELECTRIC COMPANY, 54-56-58-60-62 Clinton Street, Chicago, has made a great hit with its "wire tables," recently put out to its customers. They are beautiful works of art and are highly prized by those fortunate to receive one. The demand for these has been so great that the company has ordered another lot to be distributed shortly.

THE DAYTON GLOBE IRON WORKS COMPANY, Dayton, Ohio, has recently arranged with the Pelton Water Wheel Company, 125 Main St., San Francisco, Calif, to have the latter represent it on the Pacific Coast. The Pelton Water Wheel Company has the exclusive sales agency of the New American Turbine Water Wheel Company in its territory.

MR. FREDERICK PEARCE, 18 Rose St., New York, has just been awarded the contract to construct the new fire alarm telegraph system on Staten Island. One hundred and eighty miles of wire will be used. Mr. Pearce has just issued a very handsome catalogue of nearly 400 pages showing the various instruments made by him as well as a full line of electrical supplies.

THE CENTRAL ELECTRIC COMPANY, of Chicago, is distributing to the trade a pamphlet descriptive of the Alpha and Omega toggles, two new devices for which there is sure to be a large demand. These toggles are strong, well made and low priced. The pamphlet also contains a description of the new "Zero" solderless lug. Buyers of this material would do well to obtain a copy of the pamphlet.

ELECTRICITY IN MACHINE SHOPS.—A reprint of the paper read by Mr. Charles Day, of the firm of Dodge & Day, modernizing engineers of Philadelphia, before the New York Electrical Society on the 17th ult., on "Requirements of Machine Tool Operation with Special Reference to the Motor Drive," will be sent by mail postpaid, on application to R. D. Lillibridge, 170 Broadway, New York.

THE CRESCENT COMPANY, of Chicago, is elated over the long looked for tests made by several well-known large users of soldering flux. The tests were made on the Crescent soldering stick and Crescent paste and were highly complimentary. Considerable doubt was at first expressed due to the fact that the Crescent compounds were of such opposite mixture to the regular soldering material; but the tests indicate their wisdom and foresight.

THE BALKWILL PATTERN WORKS, 970 Hamilton Street, Cleveland, Ohio, has issued an artistic pamphlet containing the announcement of the addition to its already established business of a department for the design and manufacture of architectural and ornamental patterns of every description. Their designs will be strictly original and up-to-date. This concern makes patterns and models for machinery and will be glad to furnish estimates, etc. Mr. W. S. Wellman is general manager.

THE ELECTRIC STORAGE BATTERY COMPANY, manufacturer of the Exide battery, has recently opened a new Exide battery depot in Rochester, N. Y. Although an Exide battery station is located in Buffalo, owing to the increasing use of electric vehicles in this portion of New York State, the opening of the above office has been found necessary. It is located at the establishment of J. J. Mandery, at 157 South Avenue, Rochester. Owners of electric vehicles equipped with Exide batteries in that district are requested to use this depot for any matters requiring information or attention.

INTERNATIONAL TELEPHONE MFG. CO.—It is said that the International Telephone Manufacturing Company, of Chicago, is having a heavy demand for its generator-call telephone for long distance toll line and heavily loaded country party line use. The International instrument is especially adapted for this class of work, it being equipped with a powerful generator of extra heavy output; adjustable ringer; far-reaching, clear and distinct transmitter; double-pole horse-shoe magnet, adjustable receiver and having all connecting wires, binding posts, terminal screws, etc., concealed and no exposed metal parts forming any part of the circuit. This make of telephones is one of the most accurately constructed, most efficient and durable line of instruments ever produced.

THE STOREY MOTOR & ELECTRIC COMPANY, which has recently enlarged its shop equipment, and broadened out its line of machinery so that it covers everything that possibly can be used in work involving direct attachment of motors to machine tools, printing presses, etc., as well as a full line of open and enclosed constant speed power motors, including the necessary generators, has opened up its New York sales office in the Corporation Trust Building, 135 Broadway, New York, and has secured the services of Mr. Halbert P. Hill, who retires from the General Incandescent Arc Light Company for this purpose. This company is now undertaking the most difficult and exacting work in the line above stated. Mr. Hill anticipates being able to personally investigate the needs of the trade, and promises prompt deliveries.

THE D. L. BATES & BRO. CO., is the title of the company incorporated in Ohio, which has taken over the business of D. L. Bates & Bro., of Dayton, Ohio. Mr. D. L. Bates is president and superintendent of the factory; H. L. Bates, secretary, and R. H. Bates, vice-president and treasurer, the latter gentleman also serving in the capacity of general manager of the business. The company has recently brought out a new improved ceiling fan for the 1903 trade. It has acquired additional floor space which greatly increases its facilities for the manufacture of its fans, which have become well-known to the trade. In this connection mention may be made of a neat calendar for this year. On the card is a life-like view of four gentlemen sitting around a table in their shirt-sleeves, three of them listening to a story told by the fourth. The picture is entitled "A Hot Story in a Cool Place," the place being cooled by a Bates ceiling fan.

THE GORDON BATTERY COMPANY, 439-445 East 144th St., New York, with western offices at 358 Dearborn St., Chicago, has appointed as Pacific coast agent the Wrenn Commercial Co., Ltd., 515 Mission St., San Francisco. The Gordon cell is so extensively used throughout the country for operating central energy systems and switchboard transmitters and has given such universal satisfaction, that it has gained a large number of stanch friends among the telephone fraternity. Gordon cells are made in different sizes, varying in capacity from 100 to 1,000 ampere hours. A constant current, depending on the type, at an emf of from .65 to .75 volts can be obtained from this cell, and as there is practically no internal resistance all the emf is available. The cell is claimed to be free from noxious fumes and gases and is said to not be affected by climatic changes. It requires no attention during its life and is not consumed by local action when not in service. The company now has in preparation an enlarged catalogue fully describing the different sizes of the cell which it will be glad to send upon request.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED FEBRUARY 3, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

12,079. ELECTRICAL SWITCH OPERATING MECHANISM; C. B. Russell, Marlboro, Mass. App. filed Aug. 13, 1901. Details.

719,418. ELECTRIC ACCUMULATOR PLATE; A. Bainville, Nanterre, France. App. filed July 14, 1902. The plate consists of a number of rods separated from each other by a corrugated sheet of perforated insulating material arranged to cover the face of one rod and the back of the next, so that when plates are put together, the sheet will act as a separator.

719,432. TELEPHONIC APPARATUS; C. H. Burke, Brooklyn, N. Y. App. filed November 12, 1900. (See page 279.)

719,452. TROLLEY SYSTEM FOR ELECTRIC RAILWAYS; J. S. Fox, Jackson, Mich. App. filed June 28, 1902. A third rail having a movable cap adapted to be forced inward by the trolley wheel to make contact with a conductor located inside of the rail.

719,458. COMBINED TELEGRAPH AND TELEPHONE SYSTEM; C. H. Gaunt, St. Paul, Minn. App. filed February 15, 1902. (See page 279.)

719,463. ELECTRIC SYSTEM FOR ELEVATOR SAFETY APPLIANCES; G. Hail, Providence, R. I. App. filed April 8, 1902. An arrangement of circuits for signal lights in which the current is taken from ordinary lighting systems.

719,465. ELECTRIC CLOCK; V. Himmer and V. Himmer, Jr., Bayonne, N. J. App. filed March 15, 1902. Details of the circuit controlling mechanism.

719,471. WATER PURIFIER; Ernest Kaiser, New York, N. Y. App. filed May 8, 1902. Current passes from one set of spirally arranged plates to another set interleaved with the first.

719,484. APPARATUS FOR ELECTROTHERMALLY TREATING MATERIALS; Hudson Maxim, London, England. App. filed Aug. 17, 1898. (See page 278.)

719,504. AUTOMATIC FIRE ALARM APPARATUS; H. Plowman, London, Eng. App. filed July 3, 1901. Details.

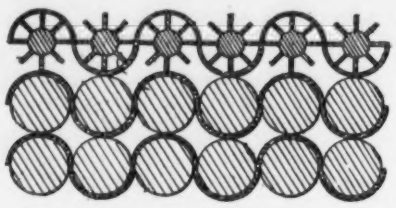
719,506. ELECTRIC LAMP; H. N. Potter, New Rochelle, N. Y. App. filed Nov. 21, 1901. A cage is arranged to shield the glower from draughts and to confine a portion of the heat of the glower and so lengthen its life.

719,507. ELECTRIC FURNACE; Henry Noel Potter, Pittsburg, Pa. App. filed Nov. 21, 1901. The furnace has a number of terminals each connected to a resistance, the object being to secure an even flow of current in the furnace.

719,508. CLAMP DEVICE FOR ELECTRIC WELDING MACHINES; A. F. Rietzel, Lynn, Mass. App. filed June 14, 1902. A clamping device arranged for quick manipulation.

719,549. LIQUID RESISTANCE SWITCH FOR ELECTRICAL PURPOSES; J. H. Wolliscroft, Sandycroft, England. App. filed Oct. 3, 1902. Details.

719,551. ELECTRIC TIME-ALARM SYSTEM; Edwin T. Ackerman, Chicago, Ill. App. filed Oct. 4, 1901. Provides means whereby all or any one of a series of different alarms may be sounded automatically at certain periods.



719,418.—Electric Accumulator Plate.

719,556. TELEGRAPH INSTRUMENT; E. Bing and H. Nevill, Pernambuco, Brazil. App. filed April 18, 1902. The cradle and syphon of a syphon recorder are balanced to be more sensitive in operation.

719,566. ELECTRIC BRAKE; F. E. Case, Schenectady, N. Y. App. filed July 31, 1899. A single handle actuates both the electric and the mechanical brakes, while means are provided for releasing the electric brake irrespective of the position of the handle.

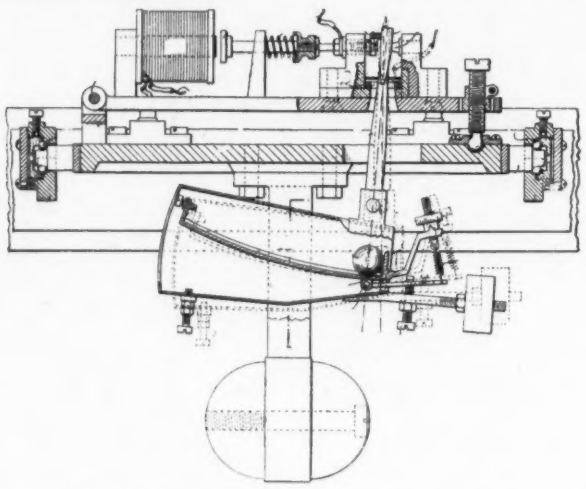
719,600. INSULATING HIGH POTENTIAL APPARATUS; W. S. Moody, Schenectady, N. Y. App. filed July 19, 1902. The brush discharge set up by the excessively high voltages extending outward from the terminals of the apparatus, is interrupted by disks of insulating material of sufficient diameter placed upon the terminals.

719,609. POWER FACTOR INDICATOR; W. H. Pratt, Lynn, Mass. App. filed June 7, 1902. Unconnected and independently movable members adapted to measure quantities each different from the other and means for combining the indications of the members to produce a single resulting indication.

719,659. GALVANIC BATTERY; H. Halsey, New York, N. Y. App. filed Sept. 21, 1901. A mechanical device for stirring the excitant liquid and for regulating the introduction of the depolarizing fluid.

719,660. ELECTRIC BATTERY; H. Halsey, New York, N. Y. App. filed April 18, 1902. Means for freeing the electrolyte of precipitates.

719,661. ELECTRIC BATTERY; H. Halsey, New York, N. Y. App. filed April 18, 1902. A plurality of concentrically arranged elements in combination with brushes and means for moving the same around the channel between the elements.



719,857.—Automatic Firing Apparatus for Ship's Guns.

719,736. SERVICE-METER SYSTEM AND APPARATUS FOR TELEPHONE EXCHANGES; A. M. Bullard, Somerville, and L. A. Falk, of Boston, Mass. App. filed April 10, 1902. (See page 279.)

719,741. SEPARATOR; J. W. Burton, Maplehill, Kan. App. filed March 28, 1902. A grain separator in which permanent magnets are used to remove the metallic particles.

719,752. VOLTAIC CELL; M. E. Conrad, Atlantic, Iowa. App. filed Dec. 18, 1900. A negative electrode composed of a metallic oxysulphid.

719,753. SYSTEM OF ELECTRICAL DISTRIBUTION; J. L. Creveling, New York, N. Y. App. filed Dec. 7, 1900. Details.

719,763. CONSTRUCTION OF UNDERGROUND CONDUITS; T. E. Devonshire, Chislehurst, England. App. filed Nov. 8, 1902. The conduit is formed of slotted lengths having body parts consisting of concrete and metal, the latter embedded in the former.

719,778. STORAGE BATTERY TANK; B. Ford, Philadelphia, Pa. App. filed Dec. 11, 1902. The cells of the tank are separated by double walls with an air space between them to catch dust and leaking acid and thus prevent short circuit.

719,791. ELECTROLYTIC CELL; R. Grisson, Hamburg, Germany. App. filed Dec. 8, 1902. A cell in which a reformation of the deformed aluminum electrodes is constantly proceeding during operation; this result is attained by avoiding any vertical active surfaces in the electrode.

719,824. ELECTRIC BRUSH HOLDER; H. T. Maker, Milwaukee, Wis. App. filed Nov. 12, 1902. A sheet metal brush holder.

719,857. AUTOMATIC FIRING APPARATUS FOR SHIP'S GUNS; H. Von Pechy and V. Rea, Pola, Austria-Hungary. App. filed Aug. 11, 1902. A pendulum apparatus in which a firing circuit is closed when the gun assumes its calculated firing angle either by the rolling of the ship or by hand adjustment.

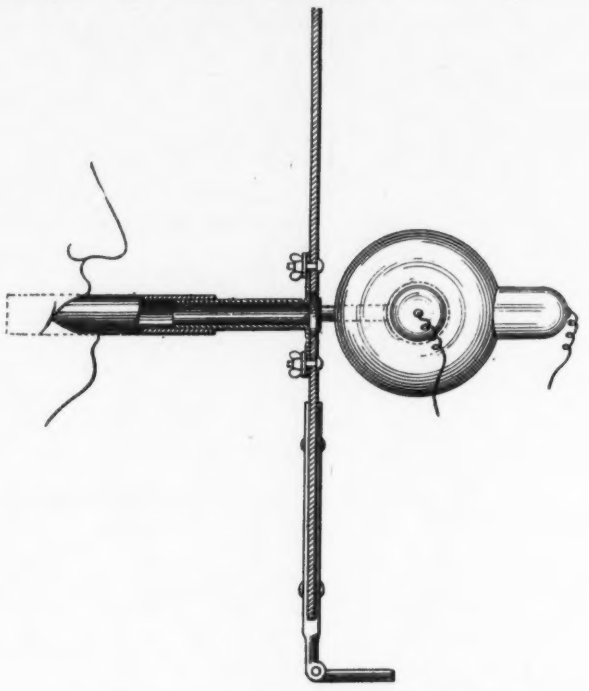
719,859. ELECTRICAL CONTACT FOR CARTRIDGE FUSES; C. D. Platt, Bridgeport, Conn. App. filed Dec. 3, 1902. Details.

719,870. ELECTROLYTIC APPARATUS; C. J. Reed, Philadelphia, Pa. App. filed May 5, 1899. Means for insuring a thorough and effective amalgamation of the metal deposited upon the cathode of the apparatus.

719,871. ELECTROLYTIC APPARATUS; C. J. Reed, Philadelphia, Pa. App. filed May 5, 1899. A modification of the preceding patent.

719,872. ELECTROLYTIC APPARATUS; C. J. Reed, Philadelphia, Pa. App. filed May 5, 1899. A modification of 719,870.

719,873. ELECTROLYTIC APPARATUS; C. J. Reed, Philadelphia, Pa. App. filed May 5, 1899. A modification of 719,870.



719,915.—X-Ray Apparatus for Treating Diseases.

719,882. METHOD OF SUB-DIVIDING BLOCKS OR INGOTS OF CARBIDE; Joseph Scales, Niagara Falls, N. Y. App. filed May 6, 1902. Holes are drilled while the block is yet hot, and water injected into the cavity through the drill to preserve the cutting edge of the drill and disintegrate the material.

719,901. PHOTOCHEMICAL AND ELECTROTHERAPEUTICAL APPARATUS; A. E. Sterne, Indianapolis, Ind. App. filed Oct. 23, 1901. Details.

719,915. X-RAY APPARATUS FOR TREATING DISEASES; H. E. Waite, New York, N. Y. App. filed March 8, 1902. An X-ray shield connected to the generator and having an opening for the passage of the rays and a tube extending from said opening, whereby the rays can be directed to a definite portion of the body and shielded from surrounding portions.

719,932. DANGER SIGNAL FOR RAILWAYS; C. P. Bass, Portland, Ore. App. filed Jan. 25, 1902. Details.

719,937. STORAGE BATTERY; B. Ford, Philadelphia, Pa. App. filed Dec. 19, 1902. A floating separator and means for holding it down.

719,953. MACHINE FOR OXIDIZING MATRICES FOR ELECTROTYPING; Charles M. Oliver, Baltimore, Md. App. filed Aug. 26, 1902. Instead of the iron-filings being brushed over the matrix surface, they are sifted on the same and washed back and forth by the copper solution, the whole being in a box with trunnions.

719,971. MAGNETO ELECTRIC GENERATOR MECHANISM; L. G. Woolley, Kenton, Ohio. App. filed May 26, 1902. A motor for moving the armature in one direction and automatically acting means for moving it in the reverse direction.

719,972. TELEPHONE-TRANSMITTER; J. A. Wotton, Atlanta, Ga. App. filed June 8, 1901. (See page 279.)

719,973. PROCESS OF MANUFACTURING ELECTRICAL CONDENSERS; J. A. Wotton, Atlanta, Ga. App. filed Jan. 23, 1902. Alternate sheets of paper and condenser plates are rolled and immersed in a bath of molten wax from which moisture has been driven off.

Supplement to ELECTRICAL WORLD AND ENGINEER, *February 14, 1903.*

CABLE CONSTRUCTION FOR TELEPHONE LINES.

General Specifications.

The necessary provisions and instructions for building a cable plant are conveniently subdivided as follows:

A CONTRACT AND GENERAL SPECIFICATIONS FOR CABLE MANUFACTURE.
1. Subscribers' Cables.
2. Trunk Cables.
3. Toll Line Cables.

B SPECIFICATIONS FOR SPLICES.
1. Main Cable Splices.
2. Branch Cable Splices.

C SPECIFICATIONS FOR TERMINALS.
1. Cable Head Terminals.
2. Flexible Terminals.

D SPECIFICATIONS FOR INSTALLATION.
1. Underground Cables.
2. Aerial Cables.

(A) CONTRACT AND GENERAL SPECIFICATIONS FOR THE MANUFACTURE OF TELEPHONE CABLES.

THIS AGREEMENT made and concluded this.....day of ..... in the year Nineteen Hundred and..... by and between the.....COMPANY, organized and existing under the laws of the State of..... having its principal business office in the City of.....State of .....party of the first part and the .....COMPANY, organized and existing under the laws of the State of..... having its principal office in the City of.....State of..... .....party of the second part, WITNESSETH:

SECTION 1.

1 Contract

That the party of the second part has agreed, and by these presents does agree, with the party of the first part, for and in consideration of the prices and agreements hereinafter stipulated, well and truly paid and performed by the party of the first part, and under penalty expressed in a bond bearing date of.....and hereunto attached, marked Section 38, to manufacture and deliver[1] and install at his own proper cost and expense each and all of the various sizes, kinds and pieces of telephone cable described in Schedule 1, Section 18, hereunto attached, entirely in accordance with these specifications.

SECTION 2.

2 Definitions

All words referring to the respective parties shall be taken of such number and gender as the character of the parties require.

(*a*) The word "Company" shall mean the ..... *Telephone Company*, of.....which has entered into this contract as party of the first part.

(*b*) The word *"Contractor"* shall mean the.....COMPANY, which has entered into this contract as party of the second part.

(*c*) The word "Inspector" shall mean the duly appointed representative of the Company, authorized to perform the various tests, inspections and examinations hereinafter specified.

(*d*) The word "Cable" shall mean an aggregate of copper wires each electrically insulated from all others and enclosed in a lead sheath or pipe hermetically sealed. Different sizes of cables shall be described by stating the number of pairs of wires which each size contains. The length of each piece shall be specified by stating the number of lineal feet it shall contain; hence each separate piece of cable is described by specifying its length in feet and the number of pairs.

(e) The word "Duct" shall mean a hole, or passageway, or pipe into which a cable may be placed, usually constructed beneath the surface of a street or alley, or in the walls or floor of a building, or along a pole of an aerial line.

(*f*) The word "Manhole" shall mean any chamber or space giving access to ducts.

[1]Cancel "and install" if cable is installed by Telephone Company.

SECTION 3.

3 Description

The work called for in this contract and specification is as follows:

(*a*) The supply of all necessary material, labor, tools and appliances to manufacture, pack, ship, transport and deliver F. O. B. cars or vessel, in the City of..... each and every piece of cable enumerated in Schedule 1, Section 18, of this indenture. The various pieces of cable scheduled shall be made and delivered in the order specified in this schedule, in Column 6, headed *"Date of Delivery."*

[2](*b*) As fast as the cable reaches the City of..... the Contractor shall proceed to install each and every piece of cable in the places specified in Schedule 1, Section 18, in Column 9, headed "Location." The location of each piece of cable is specified by stating in Column 7 opposite each piece whether it is to be placed in underground conduit, or on an aerial line, and in Column 9 the name of the street, alley, or other location along which it is to extend, and the terminal points between which it is to be placed. Column 8 specifies the terminal to which each end shall be connected. After each piece is installed in its proper place it shall be spliced by the Contractor to any and all adjoining pieces, or connected to an appropriate cable head or heads or other terminal or terminals as specified in Column 8 of Schedule 1. If one or more cable heads are used at any point to terminate a piece of cable, the heads shall be supplied by .....but the Contractor shall, at his own proper cost and expense, supply all labor and materials to properly join the cable to the head or heads.

SECTION 4.

4 Power of the Inspector

(*a*) During the manufacture of each and every piece of cable herein called for the Inspector shall have the right to examine all materials used, and test the same as hereinafter specified, and to inspect the workmanship employed, and to test as hereinafter provided, each finished piece of cable. In case any material shall fail to meet any or all the requirements, or any workmanship shall be defective, or any finished piece of cable shall not fulfill any or all of the tests hereinafter provided, the Inspector shall reject the same. The Company may, at its option, make the final tests on the finished cable either at the works of the Contractor at..... or after delivery of the cable in the City of.....

[3](*b*) After each piece of cable is installed in its place, as specified in Schedule 1, Section 18, and finally spliced or otherwise connected to the terminals specified, the Inspector shall examine and test the same as hereinafter specified.

SECTION 5.

5 Access to Work

The contractor shall at all times afford the Inspector all facilities to examine, inspect and test all materials, processes, machinery, finished cable and cable laid in place, and all opportunities to satisfy himself of the skill and competency of all men employed.

SECTION 6.

6 Orders to Contractor

Whenever the contractor is not present in person, when it may be necessary to give any instructions regarding the work herein called for, such directions as may be given by the Inspector shall be received and obeyed by the Foreman, or other persons in charge.

SECTION 7.

7 Legal authority

The necessary legal authority to work in and occupy the Streets of the City of..... .....shall be obtained by the Company and delivered to the contractor in the form of such written permits as may be necessary and customary in said City. If after the receipt of said permit the contractor shall allow the same to be lost or destroyed, the Company shall, on written notice from the contractor, take out a new permit and shall charge against the contractor all necessary expense thereof.

[2]Cancel (*b*) if cables are installed by the Company.
[3]Cancel (*b*) if cable is installed by the Company.

SECTION 8.

8 Obedience to Law and City Regulations

In all operations in any way connected with the work herein specified the contractor shall comply in all respects with all the laws of the land and all city rules and regulations affecting in any way the conduct of those engaged, or the methods of doing any or all parts of the work, or in the use of materials, tools, appliances or machines.

SECTION 9.

9 Responsibility of Contractor

During the progress of all parts of the work herein called for the contractor shall take all precautions, and shall assume all responsibility of whatsoever nature for the prevention of any and all injuries to any person whatsoever, whether employed by the contractor or not. He shall and does hereby assume all responsibility and liability for any injury of whatsoever nature to any persons or property, and shall and does hereby assume all liens, suits or claims for damages, either to life, limb, property or person, arising from any act or omission, or from the amount or character of the work, or in the way in which it is done, and shall and hereby agrees to save harmless the Company, its officers and agents, for all claims relating to any damage or injury actual or consequential, present or future.

SECTION 10.

10 Competent men and suitable tools

The contractor shall only employ competent and orderly artisans, thoroughly familiar with the work to which they are assigned. If, in the opinion of the Company, any men are employed who are incompetent or disorderly, the Company shall notify the contractor thereof and he shall forthwith remove them from the work. The Contractor shall constantly supply and maintain any and all necessary and suitable tools, machinery, appliances and material that shall be sufficient to prosecute each and every part of the work at such a rate of speed as shall ensure in the completion thereof within the time specified in Section 13.

SECTION 11.

11 Company's right to assume work

If any portion of the work herein specified shall be abandoned, or if in the opinion of the Company any of the provisions of this contract shall not be fulfilled, or any part shall be unnecessarily delayed, the Company may notify the contractor to discontinue all or any part thereof, and the Company may by contract or otherwise complete the work, or any part thereof, and charge any and all expense of such completion to the contractor. The expense so charged shall be deducted and paid by the Company out of any moneys then due, or to become due the contractor. In case such expense is less than the sum which would have been payable under this contract if the same had been completed by the contractor, he shall be paid the difference, but in case such expense shall exceed the latter sum, the contractor shall, on demand, pay such excess to the Company.

SECTION 12.

12 Acception

[4]1. As fast as the cable is received in the City of.....the Inspector shall inspect and examine it, and if the Company shall so elect, shall test the same as hereinafter provided. For all cable which entirely fulfills each and every provision of the specification the Inspector shall, as soon as inspected and accepted, issue a certificate of inspection to the contractor. On the issuance of this certificate the cable therein specified shall pass to and become the property of the Company and the responsibility of the contractor therefore shall end. All cable which does not fulfill each and every provision of the specification shall be rejected by the Inspector, and shall remain the property of the contractor. All cable which is rejected shall be replaced by that which shall fulfill all the provisions of the specification.

[5]2. After each piece of cable is installed, spliced and terminated, as specified in Schedule 1, Section 18, and entirely ready for operation, the Inspector shall test, inspect and examine the same, as hereinafter provided. For all cable which fulfills all the provisions of this specification and which is installed in a manner acceptable to the Inspector, properly spliced and terminated, the Inspector shall issue a certificate of acceptance to the contractor. On the issuance of this certificate the cable shall pass to and become the property of the Company and the contractor shall be no longer responsible therefor. Any cable which fails to fulfill any of the specification requirements, or which is improperly installed, spliced or terminated, shall be rejected by the Inspector and shall be at once removed by the contractor and replaced by cable which is in accordance with all the provisions of the specification and is properly and acceptably installed, spliced and terminated.

[4] Cancel (1) if installation is done by Contractor.
[5]Cancel (2) if installation is done by Company.

SECTION 13.

13 Time of Completion

(a) The contractor hereby agrees to commence manufacture within.....days from the date of this contract, to commence to deliver the cable called for F. O. B. cars or boat in the City of ..... on or before the.....day of.....and to continue to deliver the cable in said City F. O. B. cars or boat at the rate of.....feet each and every week thereafter until the entire amount called for in Schedule 1, Section 18, shall be so delivered.

[6](b) The contractor agrees to commence the installation of cable on the .....day of.....and to complete the installation of all the cable herein called for within.....days thereafter, Sundays and legal holidays excepted.

SECTION 14.

14 Damages for delay in completion

In case the contractor shall fail to complete the entire amount of the work herein specified within the time called for in Section 13, the Company shall have the right to deduct and retain out of the moneys which may be due or may become due the Contractor under this contract, the sum of.....dollars as liquidated damages for each and every day that the entire work herein specified shall remain uncompleted over and above the time specified in Section 13, Sundays and legal holidays excepted.

SECTION 15.

15 Liens on the work

Upon the completion of the work and before final payments are made to the contractor he shall file with the Company suitable evidence that all causes of action for damages, and all liens have been by him entirely liquidated, released and satisfied and he shall furnish to the Company a clear title to each and all parts of the work.

SECTION 16.

16 Extra work

The Contractor shall do no work nor supply any materials of any nature not herein provided for, unless authorized by a separate and supplemental contract in writing with the Company, nor shall the contractor make any claim of any nature whatsoever for the payment of any moneys except as provided for in Section 18.

SECTION 17.

17 Conditions of Payment

Between the 1st and 5th days of each calendar month the Inspector shall render to the Company a *Certificate of Estimate,* stating the number of lineal feet each kind of cable specified in Schedule 1, Section 18, that have been tested, inspected and found in all respects to have fulfilled all provisions of this contract and specifications, and shall give the contractor a copy of the same. This certificate shall also state the amount of the contract price of the cable thus tested and inspected, calculated by the prices set opposite each kind of cable in Schedule 1, Section 18. Within ten days after the rendering of the certificate of estimate the Company shall pay to the Contractor.....per cent. of the amount called for in the certificate of the Inspector and shall reserve and retain.....per cent. thereof until the completion of the entire work.

2nd. On the entire completion of all the cable called for in Schedule 1, Section 18,[7] and the complete installation of the same, and on final inspection and acceptation of the same by the Inspector as herein provided, and upon full performance in all other respects of this contract the Inspector shall so certify to the Company. Within thirty days thereafter the Company shall make to the contractor a final payment, which shall include all balances which have been reserved from the preceding monthly payments.

SECTION 18.

18 Prices for work

The Company shall pay as full compensation for each and every lineal foot of each size of cable delivered and accepted by the Inspector, and for everything done and furnished under this contract, including all damage arising out of the nature of the work, or from the action of the elements, and all risks of every description connected therewith, and for all expenses entailed in consequence of the suspension or discontinuance thereof the amounts per lineal foot for each size of cable that are set in Column 10, headed *"Price per Lineal Foot"* of Schedule attached to this Section marked *Schedule 1, Prices to be paid per Linear Foot of Cable.* The lengths specified in Schedule 1, Column 4, shall be the distances measured along the conduit or pole lines of the Company, and shall not include any allowance for splicing or terminating cable, but shall include necessary amount for slack. The Contractor shall make on each end of each piece of cable the necessary allowance for the splice or terminal, as specified in Column 8, and shall make no change for any cable used for this purpose.

[6]Cancel (b) if installation is done by the Company.
[7]Cancel "and the complete installation of the same," if installation is done by the Company.

SCHEDULE I.

1	2	3	4	5	6	7	8	9			10		
								Location where Cable is to be Installed			Prices per Linear Foot.		
Size of Cable in Number of Pairs for each Piece.	Gauge of Conductors, B. & S.	Electrostatic Capacity in Mf. Per mile.	Length in feet of each Piece.	Designation of each Piece.	Date to be Delivered.	Use Aerial or Underground.	Kind of Terminal at each end.	On	From	To	Delivered F. O. B. cars or boat in City of	For Installing and Terminating.	Total ready for Operation.

SECTION 19.

19 General Cable Specifications

(*a*) The cable called for under these specifications is that known as "Patterson Dry Core" or "Paper Cable." Each piece shall consist of a certain number of copper wires, each one insulated from all others by a loose wrapping of paper. The wires shall be twisted together in pairs and then a sufficient number of pairs to aggregate the total number required in each size of cable, shall be twisted together or "cabled" into a rope or "core." This core shall then be enclosed in a lead pipe. Cable shall be designed for either the following purpose:

(1) Subscriber's cable; namely, that to connect subscribers with central office.

(2) Trunk cable; that used to connect central offices together.

(3) Toll Line Cable; that used in the construction of "Toll" or so-called "Long Distance Lines."

This contract calls for the manufacture and delivery [8]and erection of
Subscriber's Cable.
[9]Trunk Cable.
[10]Toll Line Cable.

SECTION 20.

20 Marking and Packing

Each piece of cable shall be marked on each end by means of a metal tag upon which the designating number, according to Schedule 1, Section 18, Column 5, shall be stamped. The tags may be affixed to the ends of the cable in any manner to be readily legible, and secure from accidental removal during transportation and installation. Excepting in the case of short lengths, only one piece of cable shall be placed on a reel. At least eighteen (18″) inches of each end of every piece of cable shall be so disposed on the reel as to be readily accessible for testing without uncoiling or removing any cable.

SECTION 21.

21 Shipping

As fast as cable is completed at the factory of the contractor, the Inspector shall test the same, provided the Company elect so to do, under Section 4. All cable accepted shall immediately after acceptance be carefully coiled on proper reels, so boxed as to prevent injury during transportation and promptly shipped.

If the Company shall elect to make acceptance tests in the City of..... ..... as provided for in Section 4, the cable shall be reeled, boxed and shipped as above specified, as fast as it is manufactured.

[8]Cancel "and erection," if erection is done by the Telephone Company.

[9]Cancel "Trunk Cable" and "Toll Line Cable" if Subscriber's Cable only is desired.

[10]Cancel "Toll Line Cable" if only Subscriber's and Trunk Cable is desired.

SECTION 22.

22 Conductor material

All conductors for all cable shall be of first-class *soft-drawn* copper wire. The wire shall be true and round, and full to the gauges specified. All wire shall be free from all slivers, nicks or other imperfections. Each size of wire shall be capable of standing not less than sixty twists in a length of two inches. This test shall be applied by a standard wire torsion testing machine. All wire shall have a resistance of at least 98 per cent. of pure soft copper, Matthiessen's standard, and shall be drawn in as long lengths as possible. Necessary splicing shall not be done by twisting or soldering, but by electrical welding. The various sizes of wire shall have diameters, resistances and weights per mile, not less than those specified in Table I.

TABLE I.

DIAMETERS, WEIGHTS AND RESISTANCES OF CABLE CONDUCTORS PER MILE.

Gauge No. B. & S.	Diameter in mils.	Resistance in ohms.	Weight in pounds.
10	101.890	5.2773	165.98
14	64.084	13.3405	65.658
17	45.257	26.7885	32.786
18	40.303	33.7285	25.970
19	35.890	42.5329	20.594
20	31.961	53.6362	16.331
22	25.347	85.2743	10.272

SECTION 23.

23 Insulation

Each conductor shall be insulated from all other conductors by a continuous wrap of paper. The Contractor may use either one or more wraps of paper at pleasure, provided that the subsequent provisions for electro-static capacity and insulation shall be rigidly maintained. The paper used shall be a first-class quality; it shall be completely free from all substances which might exercise any injurious action upon either the conductors or the sheath. The paper shall be about four mills in thickness and of sufficient strength so that a piece of 1″ wide shall support a weight of not less than 2 lbs. per mill of thickness.

Each individual conductor shall be wrapped with the paper in such a manner as to completely isolate electrically each wire from every other one and the sheath. Pains shall be taken to make this wrapping as loose as possible, in order that electrostatic capacity may be reduced to a minimum. Prior to wrapping, all paper used shall be kiln dried at a temperature of about 225° F., and completely freed from moisture. The method of cable making shall be such that the paper is placed on the conductors and the conductors promptly twisted, cabled and enclosed in the sheath (and, if necessary, subsequently dried) the entire process being so conducted as to ensure the paper being perfectly dry when the cable is completed.

SECTION 24.

24 Test wires

In each piece of cable called for, one extra pair of wires over and above the number specified in Schedule 1, Section 18, shall be introduced for purposes of testing.

SECTION 25.

25 Coloring of Insulation

One pair of wires in each piece cable shall have one conductor covered with paper colored blue, and the other insulated with paper colored white or grey. All of the remaining pairs shall have the insulation of one wire colored red and the other colored white or gray. The blue paper is to designate the test pair of wires.

SECTION 26.

26 Twisting and Cabling

Each pair of conductors shall be twisted together in such a manner that the length of the twist shall not exceed 3" for wire of No. 19 gauge, or over 6" for wire of No. 17 to No. 19 gauge, and 14" for wire of No. 10 to No. 14 gauge. All pairs shall then be formed into a cylindrical core, arranged in alternately reversed layers and spiraled about one central pair with a twist, not to exceed one turn in 24 inches.

SECTION 27.

27 Sheath

The core of each cable shall be enclosed in a pipe made of (1) pure lead, and after the core is enclosed the cable shall be passed through a bath of melted tin, so applied as to give the exterior a continuous and uniform coating of tin. (2) Lead tin alloy containing about 3 per cent. of tin, in no case less than 2.85 per cent. (Cancel either (1) or (2) as may be agreed at execution of contract.) On completion the sheath shall be absolutely tight and free from all cracks, blow holes, pin holes or other defects of every nature. In case the Inspector shall suspect imperfections in the sheath the Contractor on demand shall seal one end of the cable and apply an air pressure of not over 75 pounds per square inch of dried air to the other end, and while this pressure is applied the cable shall be drawn through a tank of water, not less than 18 feet long, in order to detect any defects in the sheath. If any defects in the sheath exist they will be made manifest by escaping air, and shall be remedied; or if, in the opinion of the Inspector, this is impractical, the cable shall be rejected. When presented to the Company for acceptance the sheath shall be sound in all respects, uniform in thickness and composition; shall be round and true and free from all kinks, flat places or other defects. The thickness of the sheath shall not be less nor the external character of the completed cable more than the dimensions specified in Table 2.

TABLE 2.

MINIMUM THICKNESS OF CABLE SHEATH AND MAXIMUM OUTSIDE DIAMETER OF CABLE.

No. of pairs.	Thickness of sheath—Aerial, inches.	Thickness of sheath—Underground, inches.	Diameter, inches, Maximum.
5	3/64	1/16	5/8
10	5/64	1/16	13/16
25	5/64	3/32	1 5/16
50	3/32	7/64	1 3/4
100	7/64	1/8	2
120		1/8	2 1/8
150		1/8	2 1/4
200		1/8	2 3/8
250		9/64	2 1/2
300		5/32	2 5/8
400		5/32	2 3/4

SECTION 28.

28 Sealing

As soon as manufacture is complete the end of each piece of cable shall be sealed for a distance of not less than 2 feet by boiling in melted paraffine and the sheath hermetically soldered over the end.

[11]SECTION 29.

29 Receipt of Cable

(1) On receipt by the Company of customary freight invoice, showing the arrival of each piece and every piece of cable, in the City of.....the Company shall receive, suitably care for, and store the same.

SECTION 30.

30 Tests

By Section 4 the Company may at its option test the completed cable either at the works of the Contractor or on its arrival in the City of.....[12] or after it is installed ready for use. The tests shall consist in measuring the conductor resistance, insulation resistance and electrostatic capacity of every wire in each piece of cable, and in testing each pair of wires against every other pair for cross-talk. The method to be used for measuring conductor resistance shall be that known as the Wheatstone Bridge method. The method of measuring insulation resistance shall be either that known as *Direct Deflection*, employing a galvanometer, having a sensitiveness of not less than 750 megohms, or the method of Loss of Charge.

For the measurement of capacity each wire shall be compared by direct deflection (using a galvanometer, as above specified) with a standard condenser, adjusted to approximately the same capacity as the piece of cable under test. All apparatus used in cable inspection shall be that of well-known standard makers. In case any question as to the result of any test shall arise the accuracy of the apparatus shall be verified by sending it to any of the well-known electrical laboratories for comparison.

For the measurements of conductor resistance a battery giving not less than 10 nor more than 100 volts shall be employed. To measuring insulation resistance and capacity a battery giving not less than 200 nor more than 500 volts shall be employed.

Tests for cross-talk shall be made by providing a sound-proof enclosure, such as a regular telephone booth, of such nature that an observer located therein cannot hear any sound from conversation carried on in a very loud tone of voice, or shouted, on the exterior. The booth shall be provided with two standard double-pole receivers similar to those supplied by the Company to its regular subscribers, and from each of these receivers a twisted pair of rubber-covered wires shall be carried outside of the booth, each wire being terminated in a binding post, set on a rubber plate, secured to the outside of the booth. A standard transmitter, with proper battery and all other appliances, and receiver, similar in all respects and wired on the same circuit as regularly supplied by the Company to its subscribers, shall be provided, so arranged that one end of any cable pair may be readily connected to the transmitter and the other to the receiver. One end of any cable pair shall be connected to this transmitter and the other to the receiver. A second pair shall be taken and one of its ends connected to one of the receivers, located inside the above specified booth, and the other one to the other receiver. The Inspector entering the booth shall listen with both ears, one to each receiver, while an assistant shall talk into the above specified transmitter in a tone of voice about 50 per cent. louder, as nearly as can be estimated, than that used in ordinary telephone connections. If the Inspector can hear no sound under these circumstances he shall accept the cable for cross talk test. If he can hear any sound, but fail to distinguish articulate sounds, he may accept or reject the cable at his discretion. If he can understand conversation he shall reject the cable unqualifiedly and without appeal. The Inspector shall in this manner test each pair against each other pair, or as many pairs against as many other pairs as he may deem fit. All testing apparatus shall be supplied by the Company, but the Contractor shall supply all labor that may be needed by the Inspector in making tests.

SECTION 31.

31 Requirements

1. *CONDUCTORS.*

Each conductor shall be continuous from end to end of each piece and shall meet all the requirements of Section 22 and Table 1 therein contained.

2. *INSULATION.*

Every wire shall have an insulation resistance, after an electrification of one minute, of not less than 5,000 megohms per mile, before it is installed and connected to terminals. After any cable is installed and connected to terminals every wire therein shall have an insulation resistance of not less than 1,000 megohms per mile.

3. *ELECTROSTATIC CAPACITY.*

The electrostatic capacity of the various kinds of cable herein called are specified in Tables 3, 4 and 5, Section 32.

It is further specified that no one wire shall vary more than 12 per cent. from the capacities specified and that the average of all wires in each piece of cable shall not vary more than 7 per cent. from the amounts specified in this table.

SECTION 32.

32 Kinds of Cable

The properties of the various kind of cable herein called for are specified in Tables 3, 4 and 5.

TABLE 3.

NUMBER OF PAIRS, CONDUCTOR, GAUGE AND ELECTROSTATIC CAPACITY PER MILE OF SUBSCRIBER'S CABLE.

No. of pairs.	Conductor Gauge, B. & S.	Capacity, mf.	Conductor Gauge, B. & S.	Capacity, mf.	Conductor Gauge, B. & S.	Capacity, mf.
10	19	.080	20	.085	..	...
25	19	.080	20	.085	..	...
30	19	.080	20	.085	..	...
50	19	.080	20	.085	..	...
100	19	.080	20	.085	..	...
150	19	.080	20	.085	..	...
200	19	.110	20	.110	..	...
250	19	.110	20	.110	22	.120
300	..	...	20	.115	22	.120
350	..	...	20	.115	22	.120
400	..	...	20	.118	22	.120

TABLE 4.

NUMBER OF PAIRS, CONDUCTOR GAUGE AND ELECTROSTATIC CAPACITY PER MILE OF TRUNK CABLE.

No. of pairs.	Conductor Gauge, B. & S.	Capacity, mf.	
50	17	.065	.060
75	17	.065	.060
100	18	.075	.075

[11]Cancel Section 29 if Cable is installed by Contractor.

[12]Cancel "or after it is installed ready for use," if installation is done by Company.

TABLE 5.

NUMBER OF PAIRS, CONDUCTOR GAUGES AND ELECTROSTATIC CAPACITIES PER MILE OF TOLL LINE CABLE.

Size and Number of pairs.	Conductor Gauge, Brown & Sharpe.	Capacity.
10	10	.040
20	14	.050

SECTION 33.

33 Defective Cable

If any piece of cable shall show cross-talk as specified in Section 30 it shall be unqualifiedly rejected. In case any piece of cable shall in any other respect fail to fulfill any of the tests herein prescribed (except that for cross-talk) the Inspector shall notify the contractor of such failure. In case the contractor desires he may endeavor to repair the cable and may present the same for a second test, and if the cable shall fulfill all provisions of this specification upon second test, the Inspector shall accept same. If, on second inspection, any wire in the cable fails to meet any of the specification requirements, the Inspector shall either finally and unqualifiedly reject the cable or specifically report it, at his discretion, as hereinafter provided, and the contractor shall not present this piece of cable for a third examination and he shall at once remove the same at his own expense from the care of the Company and replace it with cable which does fulfill all of the specification requirements.

[12](2) After each piece of cable is laid in its place, spliced and connected to the terminals as specified in *Schedule 1, Section* 18, the Inspector shall measure and test it as hereinbefore provided. If the cable shall fulfill all the provisions of this specification the Inspector shall accept the same. If it shall show cross-talk, as specified in Section 30, it shall be unqualifiedly rejected. If any wire fails to fulfill any other of the provisions the Inspector shall reject the same. If, after inspection, the contractor so desires, he may endeavor to repair the cable and may present the same for a second inspection. If, on second inspection, the cable shall fulfill each and all provisions on this specification the Inspector shall accept it; but if, on second inspection, any wire fails in any particular, the Inspector shall finally reject the cable, or specifically report it at his discretion, as hereinafter provided, and the contractor shall remove the same and replace it with cable which does conform with all provisions of this specification.

(3) In case the Inspector shall find any cable in which a few of the conductors (not to exceed 10 per cent. of the entire number) shall slightly fail in some single respect to meet all the test requirements of this specification he may at his discretion make a special report to the Company reciting all the facts relating to the defective cable. If the Company, on receipt of this special report, shall so elect it may accept such piece or pieces of cable. If the Company shall so elect to accept any such defective cable it shall be at liberty to deduct from the contract price specified in Schedule 1, Section 18, such a percentage of the amount that would, if the cable were perfect, be paid therefor, as the sum of the defective wires is of the total wires in the cable.

SECTION 34.

34 Mechanical Properties

Each cable shall be so manufactured that it can, without injury to the conductors or the sheath, be coiled and uncoiled at least ten times round a drum, or sheave, having a diameter of not more than twenty times the diameter of the cable, and shall have sufficient mechanical strength so that, if handled with reasonable care by those skilled in the art, it shall be able to retain its cylindrical form during handling and other processes required for erection in place.

SECTION 35.

35 Installation

In case the installation of the cable shall be done by the contractor, he shall proceed to do all the work of erecting the various pieces of cable called for in Schedule 1, Section 18, at the places specified in column 9, headed "Location," of Schedule 1, and in the manner and by the methods of specifications B, C and D, which are attached to this indenture and are hereby made a part thereof.

SECTION 36.

36 Guarantees

The contractor shall guarantee that the insulation resistance of each piece of cable shall not decrease below 500 megohms per mile, nor shall the electrostatic capacity increase over the amounts specified in Tables 3, 4 or 5, Section 33, for a period of two years from the date of this contract, unless due to manifest mechanical injury to the sheath of the cable. As surety for the faithful performance of this guarantee the bond designated as Section 37 shall remain in force for the above specified two years.

[12]Cancel (2) if cable is installed by the Company.

SECTION 37.

37 Execution

IN WITNESS WHEREOF the parties to these presents have caused the same to be signed by their respective executive officer and their respective corporate seals to be hereto affixed the day and year above written.

(Signature first party)

.....

.....

(Signature second party)

.....

.....

(Witnesses)

.....

.....

SECTION 38.

38 Bond

BOND.

KNOW ALL MEN BY THESE PRESENTS THAT WE.....as principal, and.....we as surety.....are held and firmly bound unto the.....COMPANY, of.....in the sum of.....dollars, to be paid to the said.....COMPANY, its successors and assigns, for which payment well and truly to be made we bind ourselves, our heirs, executors, administrators and successors jointly and severally by these presents.

Sealed with our seal and dated at this.....day of ....., 19..

THE CONDITION OF THE ABOVE OBLIGATION IS SUCH THAT

Whereas the said above bounden.....has entered into a certain agreement of date herewith in which the.....is party of the first part, and the said.....is the party of the second part, for the full terms used and particulars hereof express reference is hereby made to such agreement, and by this reference it is made a part hereof, to which this bond is annexed.

NOW THEREFORE, if the said.....shall in all things fully and faithfully keep and perform said agreement and each and every term and part thereof, then this obligation shall be void, otherwise it shall remain in full force.

WITNESS OUR NAMES AND SEALS.

.....Seal.
.....Seal.
.....Seal.

(Witnesses)

.....
.....
.....

(B) SPECIFICATIONS FOR CABLE SPLICES.

1. MAIN CABLE SPLICES.

SECTION 39.

39 General Method.

Splices in paper cable shall be made by stripping the sheath from one end of each piece to be joined for a distance of from 12" to 20", depending on the size of the cable, removing the paper insulation from each wire of each piece for about an inch, twisting each red-colored wire of *one* cable to a corresponding red wire in the *other*, twisting each white wire in one piece in a similar manner, to a white one in the other piece, protecting each wire joint with a paper sleeve, replacing the removed sheath with a lead sleeve wiped to the sheath of each cable, boiling out the completed joint in paraffine, and soldering the holes left in the sleeve to allow of boiling. The general method of making a splice is shown in Fig. 1.

SECTION 40.

40 Material Required

PAPER SLEEVES

of rolled paper, 3" long, ⅛" diameter, boiled in paraffine, one for each wire to be spliced.

PARAFFINE.

Best quality, of Standard Oil Company manufacture, free from moisture, acid, or any substance injurious to the cable; a sufficient quantity to fill a pot or pan in which the splice can be completely immersed.

SOLDER.

Fifty per cent. tin, fifty per cent. lead; enough to fill a solder pot.

WICKING.

COTTON; one large ball.

LEAD SLEEVES.

Pure lead. One sleeve for each splice. sizes to be as per Table No. 6.

TABLE 6.

SIZES OF LEAD SLEEVES FOR MAIN CABLE SPLICES.

			Length. inches.		Diameter. inches.		Thickness. inches.
400	Pair	Cable	40	×	4	×	5/16
350	"	"	38	×	4	×	5/16
300	"	"	36	×	3½	×	5/16
250	"	"	34	×	3⅜	×	5/16
200	"	"	32	×	3¼	×	⅜
150	"	"	30	×	3	×	⅜
120	"	"	28	×	2¾	×	⅜
100	"	"	28	×	2½	×	⅜
50	"	"	28	×	2	×	5/32
30	"	"	26	×	1½	×	5/32
25	"	"	25	×	1½	×	5/32
15	"	"	24	×	1	×	5/32
10	"	"	20	×	1	×	5/32

While this table gives general dimensions for lead sleeves, they shall always be about ¼ inch larger than the sheathes of the cables to be spliced, from 5/32 to 5/16 inch in thickness, and long enough to allow the splicing of all conductors without producing bunching sufficient to prevent the splice from entering the sleeve, and with sufficient lap to cover each cable sheath at least 1½ inches.

SECTION 41.

41 Operation

Remove from 12 to 20 inches of each cable sheath, as shown in Fig. 1, bind the core at the end of each sheath tightly with wicking, packing the binding close to the end of each sheath, as shown, to prevent paraffine from following the core. Boil out each end by an immersing it in melted paraffine, heated to from 225 to 250° F., till all bubbling ceases. Each end shall be immersed so that the cotton binding is thoroughly saturated with paraffine. Slip the lead sleeve over one cable, slip a paper sleeve over each wire in one cable, splice each wire of every pair in one cable to the correspondingly colored wire in a pair in the other cable, by stripping the paper from each wire for a distance of about one inch and twisting the ends tightly together, as shown at *B* and *C*, Fig. 1. After twisting bend the twist parallel with the wire, slip the paper sleeve over the twist as insulation as at *D*. Care shall be exercised not to nick or injure any wire in removing the paper. Each twist shall include about ¼-inch of paper-covered wire. No solder shall be used. The twisted wire joints shall be so distributed that the splice shall be essentially uniform in diameter throughout its length. When all the wire joints are completed the splice shall be immersed in boiling paraffine for fifteen minutes, or until all bubbling ceases. The lead sleeve shall then be slipped over the splice, so that it may lap the lead of each cable sheath for 1½ to 2 inches. The ends of the sleeve shall then be dressed into close contact with the cable sheath and each end wiped to its respective cable sheath. After the wiping is done the sleeve shall be finally boiled by immersing it in boiling paraffine. A small hole shall be drilled at each end of the sleeve to admit the paraffine and give exit to contained air. These holes shall be drilled along the axis of the cable. When cold the surplus paraffine shall be cleaned off, all wiped joints dressed and the holes soldered up smooth and clean and the job left in a neat and in a workmanlike manner. After each splice is completed the cable shall be tested for conductivity and insulation, as specified in A 1, Section 30.

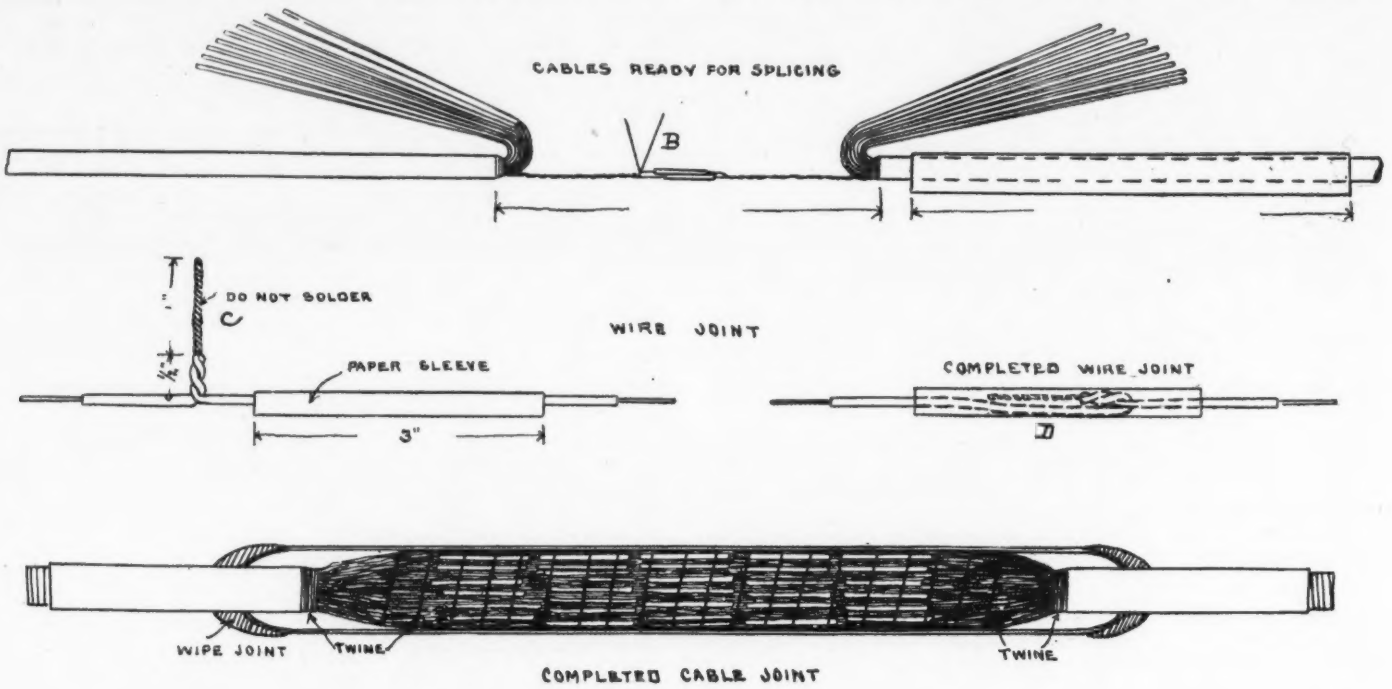


FIG. 1.

(B) SPECIFICATION FOR CABLE SPLICES.

2. BRANCH CABLE SPLICES.

SECTION 42.

42 General Description

The method of making splices in paper cables whereby a cable is legged to another cable, or where one cable is branched into two or more other cables is essentially similar to that described in B 1, specification for Main Cable Splices, and is illustrated in Fig. 2.

SECTION 43.

43 Materials

The materials to be used shall be the same as specified in B 1, Section 40, for the same size of cable. Where necessary, split sleeves may be used, as shown at *B*, Fig. 2. If a split sleeve is used the splice must be taped with okonite, and split in the sleeve soldered up air tight.

SECTION 44.

44 Operation Legged Cable

The method of making legged cable splices shall be exactly the same as that specified for main cable splices in B 1, excepting that each wire of the main cable shall be continuous through the splice into the main cable on both sides of the splice, and each wire of the legged cable shall be spliced on to such a wire of the main cable as is designated for this purpose. All the wires in both the main cable and the branch cable shall be numbered and the wires in the branch cable shall be spliced to such corresponding numbers in the main cable as shall be designated at the time the splice is made. On the completion of the splice all the wires of both the main cable and the branch cable shall be tested completely from one terminal to the other, both for conductivity and for insulation, as specified in A 1, Section 30, and shall fulfill all the tests therein called for.

SECTION 45.

45 Operation Branched Cable

The method of making branched cable splices shall be exactly the same as that specified for legged cable splices in Section 44, excepting that a certain number of wires in the one cable shall be designated to a corresponding number of wires in each branch and shall be spliced to the branch cable wires and shall not be continued in any other cable.

(C) SPECIFICATIONS FOR TERMINALS.

1. CABLE HEAD TERMINALS.

SECTION 46.

46 Supply of Cable Heads

The cable heads shall be supplied by..... .....and shall be delivered free of expense to .....at .....office. Cable heads shall be of the type known in the trade as the.....cable head. Pole cable heads of the type known as.....

47 Specification for Heads

SECTION 47.

(A) *PLAIN HEADS.*

1. Each cable head shall be supplied with a brass sleeve of proper size to fit the sheaths of the cable it is intended to terminate. This sleeve shall be strong and substantial and so fitted to the head as to make a solid and air-tight joint.

2. Each head shall be supplied with as many insulated pins extending from the inside of the head to the outside of the head thereof as there are wires in the cable to which the head is to be attached. These pins shall be so constructed as to maintain an insulation of not less than 1,000 megohm pin to pin and pin to ground. They shall be strong and substantial, and so set as to make the interior of the head air-tight. Each pin shall be supplied at each end with a nut, or screw-head, or slot for soldering, or other means for attaching the cable wire approved by the Company.

3. The space occupied by the cable wire shall be capable of being hermetically sealed in such a manner as to prevent any moisture from reaching the cable, and yet so built that access can be had to the cable with the least amount of work.

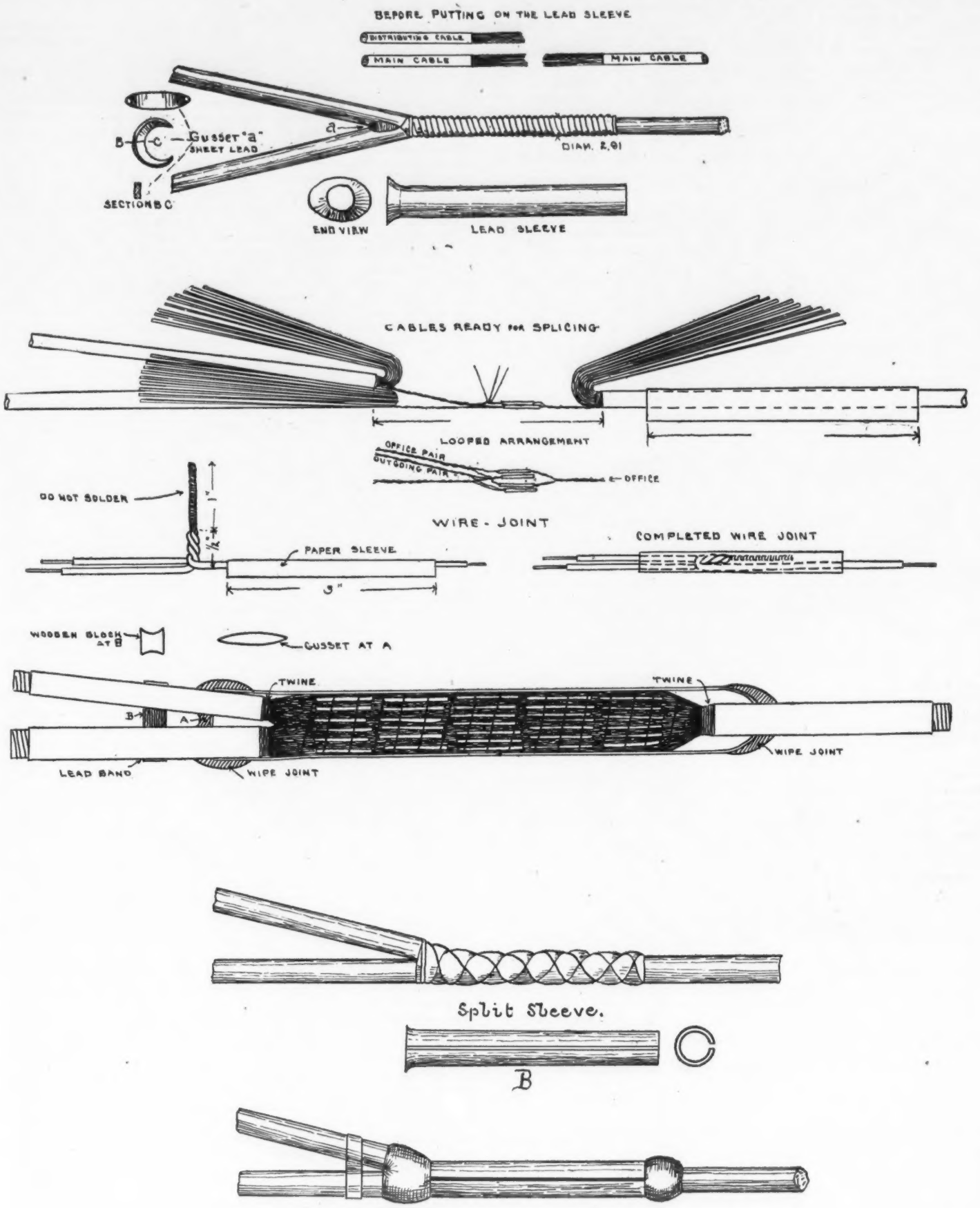


FIG. 2.

(B) *PROTECTED HEADS.*

Protected heads shall fulfill all the specifications of A of this section and in addition shall be supplied with devices approved by the Company to protect the cable conductors from lightning or from strong currents, or both, as the Company may direct.

1. *LIGHTNING GUARDS.*

Lightning guards shall consist of a spark gap composed of a pair of carbon plates separated by an insulating septum of material approved by the Company not over one hundredth of an inch (.01) thick. One plate shall be connected to the line, the other to the ground. The plates shall be held in place by a metal spring or socket, so designated as to permit them to be easily replaced, yet capable of retaining them constantly in good working condition. When any arrester operates it shall permanently ground the line. The lightning arrester shall be placed between the fuse and the cable. There shall be one arrester for each wire.

2. *STRONG CURRENT ARRESTERS.*

Strong current arresters shall consist of a fuse or a "heat coil," as the Company may elect.

(*a*) Fuses for cable heads to be used on line poles shall be of the "enclosed type," consisting of a lead or lead alloy wire enclosed in an insulated tube. The fuse shall blow at not over seven amperes nor less than five amperes. The fuse gap shall be not less than 2½ inches long. Fuses shall be waterproof and so made that fuse wire is protected from accidental injury and connected to the cable head substantially and easily replacable when blown.

(*c*) Fuses for office heads may be of the type known as "Maxstadt," composed of a fuse wire supported on an insulating base. They shall have a carrying capacity of not over 1.25 amperes or less than .6 ampere. They shall be so mounted on the head as to be protected from accidental injury, yet easily replaceable.

(*d*) Heat coils shall be so designated as to open the switchboard side of the line and ground the cable side when they operate. Heat coils shall have a carrying capacity of not less than .5 ampere or more than .75 ampere. Shall be so arranged as to sound an alarm when they operate, wholly and substantially made and easily replaceable.

SECTION 48.

48 Method of Terminating

The lead sheath shall be stripped off of the cable for a sufficient distance to allow the end of the sheath to be soldered to the metallic terminal of the cable head and leave such a length of the conductors freed from the sheath as may be sufficient to make the proper wire form to reach each and all of the terminal pins on the interior of the cable head. After the sheath is stripped the core adjacent to the end of the sheathing shall be lashed with twine or wicking, as specified under B 1, Section 41. The end of the cable shall then be immersed in melted paraffine and boiled until all bubbling ceases and in such a manner that the paraffine shall penetrate at least 18 inches inside of the cable sheath and hermetically seal it. After the boiling is complete and the cable is cool the end shall be passed into the head. The core of the cable shall then be fanned out and the wires so formed and lashed with waxed twine as to make a proper form to fit the terminal arrangement of the cable head. This form may be made by any method which shall be capable of yielding a neat and workmanlike form, substantially lashed and accurately spaced to match the terminal pins in the head. On the completion of this from the paper insulation shall be stripped off for about one inch on the ends of each wire. The sheath shall then be soldered to the cablehead terminal with a wiped joint of solder, half lead and half tin, in such a manner as to make a solid, substantial and absolutely air-tight joint. When this joint is complete the form shall be bent into its proper place inside the cable head and each wire shall be carefully and thoroughly soldered to each terminal pin of the cable head or otherwise fastened thereto. In making soldered connections no acid or other corrosive soldering flux shall be used. Rosin only shall be employed to make solder flow. After each wire is properly fastened to its appropriate pin the whole form inside the cable head shall be thoroughly shellaced with thick, unstrained shellac varnish, or other approved waterproof coating, a sufficient number of coats being applied to thoroughly cover all the paper of the form and all the wires to and including the terminal pins inside of the head, with a thick, substantial coat, sufficient to exclude all moisture and to render the form waterproof. The cover of the cable head shall then be put in place and carefully sealed in such manner as to make a moistureproof joint.

(C) SPECIFICATION FOR CABLE TERMINALS.

2. FLEXIBLE TERMINALS.

SECTION 49.

49 Description

Flexible terminals shall be made by splicing to paper cables a supplementary cable or wire form of such a number of insulated wires as shall correspond to the number of wires in the cable, said supplementary form being composed of insulated wires, protected with some kind of insulation, which shall be moistureproof and which shall prevent the entrance of moisture to the paper cable. Said supplementary form shall be of such length and so arranged as to reach and match the distributing boards, terminals or other pieces of apparatus to which the cable is to be attached.

SECTION 50.

50 Okonite Terminals

The okonite flexible terminal shall consist of a form made of okonite twisted pairs sufficient to extend each of the paper cable pairs to their proper terminal pins.

SECTION 51.

51 Material

LEAD SLEEVES to be of unalloyed lead ⅛-inch thick and of dimensions according to Table 7 of this section. About three-fourths the length of each sleeve should be drifted out of the proper size to cover the splice.

FLEXIBLE TERMINALS.—Twisted pairs of black and red okonite, No. 19 gauge, 2/32-inch insulation, without braid or other external covering. Each okonite pair shall project beyond the terminal for such a length as may be requisite to reach the terminating point of said pair.

OKONITE TAPE.—¾-inch wide, 1 roll.

PAPER SLEEVES.—As per B 1, Section 40.

BRASS TUBING.—One piece of thin annealed brass tube ½-inch in diameter, 2½ inches less in length than that of the lead sleeve.

WICKING.—As per B 1, Section 40.

WIPING SOLDER.—Containing 50 per cent. tin, a sufficient quantity.

SEALING COMPOUND.—Sealing compound shall be composed of 10 per cent., by weight, of heavy rosin oil and 90 per cent. of D. D. insulating compound. In place of D. D., Chatterton compound or any first-class waterproof rubber semi-elastic cable sealing compound may be used, which, when melted, will readily flow into the sleeve around the okonite wires and firmly adhere to both wire and sleeve. No compound which contains any paraffine derivative or similar substance capable of affecting the rubber of the okonite shall be used.

TABLE 7.

APPROXIMATE QUANTITIES AND DIMENSIONS OF MATERIALS REQUIRED FOR DIFFERENT SIZES OF TERMINALS.

Size of Cable.	—Lead Sleeves— Length. inches.	Inside diameter. inches.	Sealing compound. pounds.	Solder. pounds.	Rubber Tape. pounds.
10	16	1⅜	2	½	½
25	20	2	3½	½	½
50	20	2½	4½	½	½
100	24	3	4½	1	¾
150	24	3½	6½	1	1
200	28	3¾	7½	1½	1
250	30	4	9	1½	1
300	32	4½	10	2	1½
350	34	4½	13	2	1½
400	36	4¾	15	2	2

SECTION 52.

52 Operation

Fig. 3 is a detail drawing showing the construction of a flexible terminal. The cable sheath shall be removed for 12 to 24 inches, depending on the size of cable. The cable core shall be thoroughly dried out, *without boiling in paraffine.* Slip lead sleeve over the cable, splice each cable wire to corresponding okonite wires by twisting the ends together and protecting with paper sleeve, as described in Specification B 1, Section 41, joining the colored wire of the cable to the red okonite of each pair. Keep all wire splices within a limit of from 10 to 20 inches from the end of the cable sheath. Remove all bits of paper or other debris; bind the cable wires at the sheath tightly with several layers of twine to prevent the compound entering the cable. Tape the okonite together tightly for two or three inches, depending upon size of cable, at such a point as will bring the taping at least ½-inch below the subsequent surface of the compound. Below the taping separate the wires to freely allow the compound to flow between them. Bind the brass tubing with twine lightly along the wires with the lower end opposite the end of the cable sheath. No binding twine shall be placed beyond the wire splices. Draw the lead sleeve over the splice until it laps the head of the cable 1½ inches, then wipe the sleeve into place. Place the splice upright, warm the sleeve until it can hardly be touched with the hand. Insert a funnel into the brass tube and pour in compound, previously heated to about 350° F., slowly until it fills the sleeve within ½-inch from the top. Before filling the sleeve, test the compound by immersing therein a piece of okonite wire for about two minutes. If the insulation of the wire is not so softened as to readily come off the compound is not too hot. After filling the sleeve allow the splice to become thoroughly cold. If any settlement appears refill with compound. If there is no settlement dress the top of the lead into contact with the okonite tape, as shown in Fig. 3. Mark the outside of the sleeve, where the brass tube ends, and cover the end of the thus completed joint with two layers of okonite extending from the first wrapping tape over the edges of the sleeve. *No paraffine or any similar substance shall be used in connection with terminals of rubber-covered wire. Cables must be dried by dry heat.*

SECTION 53.

53 Distributing Board Terminals

When terminals are made for distributing boards, to be used in reasonably dry locations, leaded or unleaded switchboard cable, or wool cable, may, at the option of the Company, be substituted for okonite.

SECTION 54.

54 Unleaded Switch-Board Cable

For this purpose, first-class quality of silk and cotton twenty-pair (20) switchboard cable shall be employed, and a sufficient number of switchboard cables used to match the wires in the paper cable. These cables shall be substituted for the okonite, specified in Section 50, and the pothead made up exactly in the same manner as if okonite was employed.

SECTION 55.

55 Lead Covered Switchboard Cable

If the distance from the potheads to the distributing frame is considerable, leaded switchboard cable shall be used to maintain good insulation. The lead sheath of the switchboard cable shall only be removed from the switchboard cable for such a distance as will expose a sufficient length to splice to the wires of the wire plant cable, thus allowing the lead sheath of each switchboard cable to extend not less than four (4) inches inside of the lead sleeve forming the pothead. When the switchboard cables are ready to splice to the wire plant cable a round lead disk shall be prepared ⅛-inch thick, of such a size as to closely fit into the lead sleeve of the pothead. This disk shall have such a number of holes bored in it as will accommodate the number of switchboard cables to be spliced into the pothead, the holes being 1/64-inch larger than outside of the lead of the switchboard cables. This disk shall then be slipped on to the switchboard cables and the switchboard cables spliced to the wire plant cable. The lead sleeve of the pothead shall then be slipped into place and wiped on to the lead of the wire plant cable. The sleeve shall then be filled with dried sand, packed and rammed as closely as possible to within two (2) inches of the top of the lead. The lead disk above specified shall then be slipped along the switchboard cables and forced inside of the pothead sleeve down upon the top of the sand, so as to be about 1⅞-inches below the top of the pothead sleeve. The lead of the sleeve, the lead disk and the lead of the switchboard cables shall then be carefully cleaned and wiping solder shall proofed, if so ordered by the Company. All potheads and cableheads shall be thoroughly secured to the supports provided in a neat and substantial manner satisfactory to the Company; all cable shall be laid neatly and compactly in the runs provided, and the entire work finished in a neat and workmanlike manner and to the satisfaction of the Company.

SECTION 58.

58 Supports

All the necessary racks and supports for holding any and all cable and all terminals shall be provided by.....

(D) SPECIFICATIONS FOR CABLE INSTALLATION.

1. UNDERGROUND CABLES.

SECTION 59.

59 Preparation of Manhole and Ducts

The ducts into which the cable is to be installed shall be designated by the Company. When the cable to be installed is delivered, the manholes into which the ducts open shall be cleaned and any cable in them carefully and neatly packed against the walls to give as good access as possible to the ducts into which the new cable is to be placed. Each duct shall then be cleaned by drawing through the duct a steel brush, as specified in *Specifications for Underground Conduit, Section 26.* If a fish wire is already in the duct, it may be used to draw in the proper rope for the brush. If there is no fish wire the duct must be rodded, as described in *Specifications for Underground Conduit, Section 26.* The cable shall not be started into the duct till it is clean and far from obstruction. The mouth of each duct, while the cable is being drawn in, shall be protected by a shield of leather or guard so arranged as to prevent the edge of the duct from injuring the cable sheath.

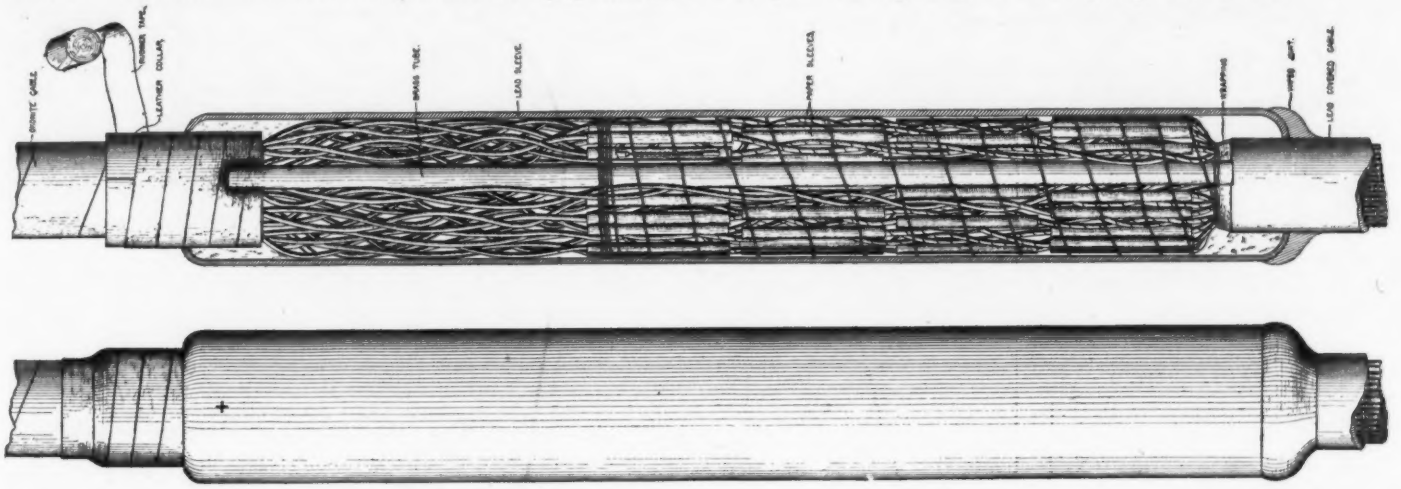


FIG. 3.

be poured in on top of the lead disk and around the lead of the switchboard cables so as to make a soldered joint between the sleeve and the lead of the switchboard cables. After the joint has cooled the lead sleeve shall be trimmed off carefully and the whole joint finished in a neat and workmanlike manner.

SECTION 56.

56 Wool Cable Terminals

Wire insulated with wool is to a considerable degree non-inflammable and non-hygroscopic, and may be used to join wire plant cables to distributing boards. Such wool cables shall be joined to the wire plant cables at some point where the splices can be conveniently laid up in a horizontal position. When connected to underground cables the best place is in the office manhole or in the basement run in of building, at the option of the Company. When joined to aerial cables the best place is the horizontal run of cable after entering the building. The length of wool cable for each incoming cable shall not be less than fifteen (15) feet. The wool cable shall be joined to the wire plant cable by means of a splice made according to Specification B 1. The lead covering of the wool cable shall be preserved on that cable up to the point where the first wires must branch away, and at this point the whole core shall be firmly bound with tape.

SECTION 57.

57 Terminal Forms

After the flexible cable is spliced to the wire plant cable, irrespective of the kind of material used for the purpose, the flexible end shall be carefully and neatly formed to match the terminal to which it is to be attached. The end of each wire shall be bared for half an inch and securely and substantially attached to the terminal designated by the Company for the purpose. The form shall be securely and neatly lashed in its place to the support provided and thoroughly shellacked or otherwise water-

SECTION 60.

60 Attachment of Pull Rope and Drawing

The pull rope shall be so attached to the cable with a swivel as to distribute the stress of drawing in uniformly over the entire cable without twist in such a manner that neither the sheath or core shall be strained or injured in the slightest degree. Power for drawing may be supplied in any desired way, either manually or by horsepower, or, preferably, with a hoisting engine, but it must be sufficient and adequate for the purpose and completely under control. When the cable has once started it shall be drawn slowly and steadily without stopping at the rate of from five to ten feet per minute, until it is completely in its final place.

SECTION 61.

61 Arrangement of Reel

The reel holding the cable shall be carefully transported without unboxing to the manholes at which drawing in is to begin. Here the reel shall be mounted on an axle of such a height as will cause it to clear the street about 6 inches and so that it shall easily and freely revolve. The reel shall be set close to the manhole, so that the cable can feed directly into the mouth of cover without dragging on the ground.

SECTION 62.

62 Feeding Cable

The cable shall be fed into the duct in such a manner as to produce the least strain in pulling and so as to absolutely avoid all kinks or other injuries to the sheath. As of necessity conduit manholes differ greatly in size, shape and accessibility, it is impossible to specify exactly the outfit needed for each case; but sufficient rollers, sheaves, guides, or other mechanical appliances or a sufficient force shall be provided to accomplish the result specified.

SECTION 63.

63 Splicing

When the cable is properly drawn into place the ends of the cable shall be coiled down into the manhole, ready for splicing. In case the cable is cut from a longer section, a sufficient amount shall be allowed for splicing and splicing shall be done immediately, or else the cut ends shall be boiled in paraffine and hermetically soldered. The reel, with any remaining cable, shall be carefully reboxed, removed at once from the street, and stored.

(D) SPECIFICATIONS FOR CABLE INSTALLATION.

2. AERIAL CABLE.

SECTION 64.

64 General Description

The work of installing aerial cable on existing pole lines may be divided into two parts:

First. The installation of the necessary messenger strands required to support the cable.

Second. The erection of the cable upon the messenger wire; the termination of the cable at each end by splicing to some other cable, or the installation of a cablehead or flexible terminal, set either in the office or in a pole box, with or without balcony.

SECTION 65.

65 Steel Strands

All wire used for strands shall be of steel, cylindrical in section, uniform in quality and free from all die marks, scales, sand splits, flaws or other imperfections. Each wire shall be double galvanized and shall fulfill the tests for galvanizing given in *Specifications for Aerial Lines.*

Each strand shall contain not less than seven wires laid up in a neat and uniform manner, showing no loose or imperfect places. The tensile strength of a section containing a wire that is spliced shall be as high as the tensile strength of a section containing no splice.

The properties of strands shall be as Table 8.

TABLE 8.

TENSILE STRENGTH OF STRANDS IN LBS.

Diameter Strand.	Diameter Wire.	Bessemer Working.	Bessemer Ultimate.	Siemens Working.	Siemens Ultimate.	High Steel Working.	High Steel Ultimate.	Extra High Working.	Extra High Ultimate.	Lay of Strand.
¼ inch	.072	600	2500	762	3050	1275	5100	1900	7600	3 inches.
5/16 "	.109	1050	4200	1215	4860	2025	8100	3025	12100	3½ "
⅜ "	.120	1425	5700	1700	6800	2875	11500	4312	17250	3½ "
7/16 "	.134	1900	7600	1750	7000	3750	15000	5625	22500	4 "
½ "	.165	2450	9800	2750	11000	4500	18000	6750	27000	4½ "

SECTION 66.

66 Installation of Messenger Wire

Each messenger shall be made of wire rope, as specified in Section 65. The stress to which messengers shall be subjected is specified in Table 9, and the size of each messenger shall be selected from Table 8, in Section 65, from the column headed "Working Strength." When not more than two cables are to be erected on one line of poles each strand shall be supported by a messenger support similar to that shown at *A*, Fig. 4. For each strand one of these supports shall be bolted upon each pole, each about one foot below the lowest crossarm, and in such a manner that the axis of the groove *B* of the support is perpendicular to the crossarm. Upon each line of poles the supports shall be bolted relatively on the same side of the pole, so that the messenger may be strung in an essentially straight line. The messenger supports may be placed on the pole in advance, and the strands subsequently drawn in place, or the strands and supports erected simultaneously.

When the messenger supports are properly bolted to the pole the strand shall be erected by drawing it from its reel and placing it in the groove marked *B*, Fig. 4, and clamping it tightly in the support by means of the upper plate and bolts.

SECTION 67.

67 Angle Iron Cross Arms

Wherever more than two cables are to be erected upon one pole line an angle iron crossarm shall be used. This angle iron crossarm shall consist of a piece of 3 x 4 inch angle, weighing 30 to 36 pounds per yard, which shall be bolted to the pole in the place of the ordinary crossarm in the lowest gain. The method of securing this angle iron to the pole and of inserting therein the ordinary wooden crossarm is fully shown in Fig. 4 at *C, D* and *E*. From this drawing it is seen that the angle iron arm is placed underneath the regular crossarm, and the whole set in the lowest gain and bolted to the pole in the usual manner as specified for aerial lines. In addition, two 1-inch bolts are inserted in the angle iron, over which a band is placed encircling the pole, as shown in Fig. 4 at *C* and *E*. Further, the crossarm shall be stayed by four crossarm braces, two on the inside and two outside of the arm. For each cable which the line is to carry a Standard U-bolt, shown at *F*, Fig. 4, shall be placed in the angle iron arm in the manner shown at *G*. Each angle iron crossarm, when erected, shall be supplied with four standard U-bolts, two on each end of the arm, as shown at *G*. When each messenger wire is erected the lower plate of this U-bolt shall be removed, the messenger inserted between the arms of the U, and the plate replaced and bolted into place.

SECTION 68.

68 Tension for Messengers

After each messenger wire is erected in place all of the bolts of the supports, whether U-bolts or standard messenger supports, shall be loosened and the tension of the strand adjusted, so as to bring a uniform strain at all the poles. This shall be accomplished by so loosening all the support fastenings that the strand is free to slide from span to span along the whole length of the pole line. The proper tension to which messenger strands shall be adjusted may be ascertained by the center deflection of the strand at the middle of each span. The proper center deflection to which messengers shall be adjusted for temperatures from 20° below zero, F., to 100° F., and for 80-ft., 100-ft., 120-ft., 150-ft. and 200-ft. spans, and for 50, 100 and 150-pair cable, is shown in Table 9.

As fast as the messenger wire is adjusted to the proper tension, all fastenings shall be screwed up solidly and substantially so as to hold the messenger firmly in place.

SECTION 69.

69 Anchoring

Wherever corners are turned, and at each end of each pole line, particular pains shall be taken to reinforce the line in a solid and substantial manner in order that the adequate strength may be secured to resist the strain introduced by the cables. The various methods that may be used for anchoring are given in detail in *Specifications for Aerial Lines.* Special methods applicable particularly to aerial cable construction are shown in Fig. 5, and each end of the line shall be guyed and anchored substantially in accordance therewith.

SECTION 70.

70 Erection of Cable

After the messenger wire is in its place and adjusted to proper sag and the various ends and corners of the lines guyed as hereinbefore specified, the aerial cable shall be erected. The reel carrying the cable shall be carefully transported and set about one span away from the pole upon which the cable is to terminate. The reel shall be mounted upon an axle so that it may freely revolve and so placed that it is about 6 inches above the ground and carefully unboxed. From the terminal pole to the reel a 3/8-inch or ½-inch guide wire strand shall be erected, serving to carry the cable from the reel to the terminal pole. At the terminal pole a large wooden sheave shall be placed immediately below the messenger over which the cable shall run. A sufficient length of rope shall be provided, supported on pulleys at each pole, to extend from the pulling apparatus, which shall be located beyond the other terminal pole, along the entire length of the span to the reel, so that the cable may be pulled into place at one operation. Power for pulling the cable may be supplied in any desired manner, either by a capston operated by manual or horsepower, or preferably a small hoisting engine. Whatever apparatus is used it shall be fully under control and capable of pulling the cable uniformly and steadily, after it is started, at the rate of from 10 to 20 feet per minute. The pulling rope shall be carried over the wooden sheave before specified down to the reel and attached to the cable by means of a swivel in such a manner as to distribute the pulling strain uniformly over the core and sheath of the cable, so that neither may be in any wise injured as the cable is drawn along.

SECTION 71.

71 Cable Supports

Such cable clips shall be used as shall be approved by the Company and sufficient hangers shall be employed, so that one may be placed every two feet throughout the entire length of each piece of cable. Actual erection of the cable shall be accomplished by placing one man at the reel to control the unwinding of the cable and sufficient force between the reel and the first pole to place upon the cable the hereinbefore specified hangers and to hook the same upon the guide wires; two men upon the first pole to guide cable over the guide sheave, and one man on each pole to unhook and hook hangers as the cable passes the messenger supports, and a sufficient force at the pulling engine to operate that portion of the apparatus. After drawing is commenced it shall proceed uniformly and steadily until the entire length of cable is erected. When the cable is in its place on the messenger wire a man shall be sent over the line to adjust all hooks in their proper position; he shall see that the hooks are properly attached to both the messenger wire and the cable and are so secured as to be safe against unhooking. When the attachment to the messenger wire as above specified is accomplished the tension on the cable and on

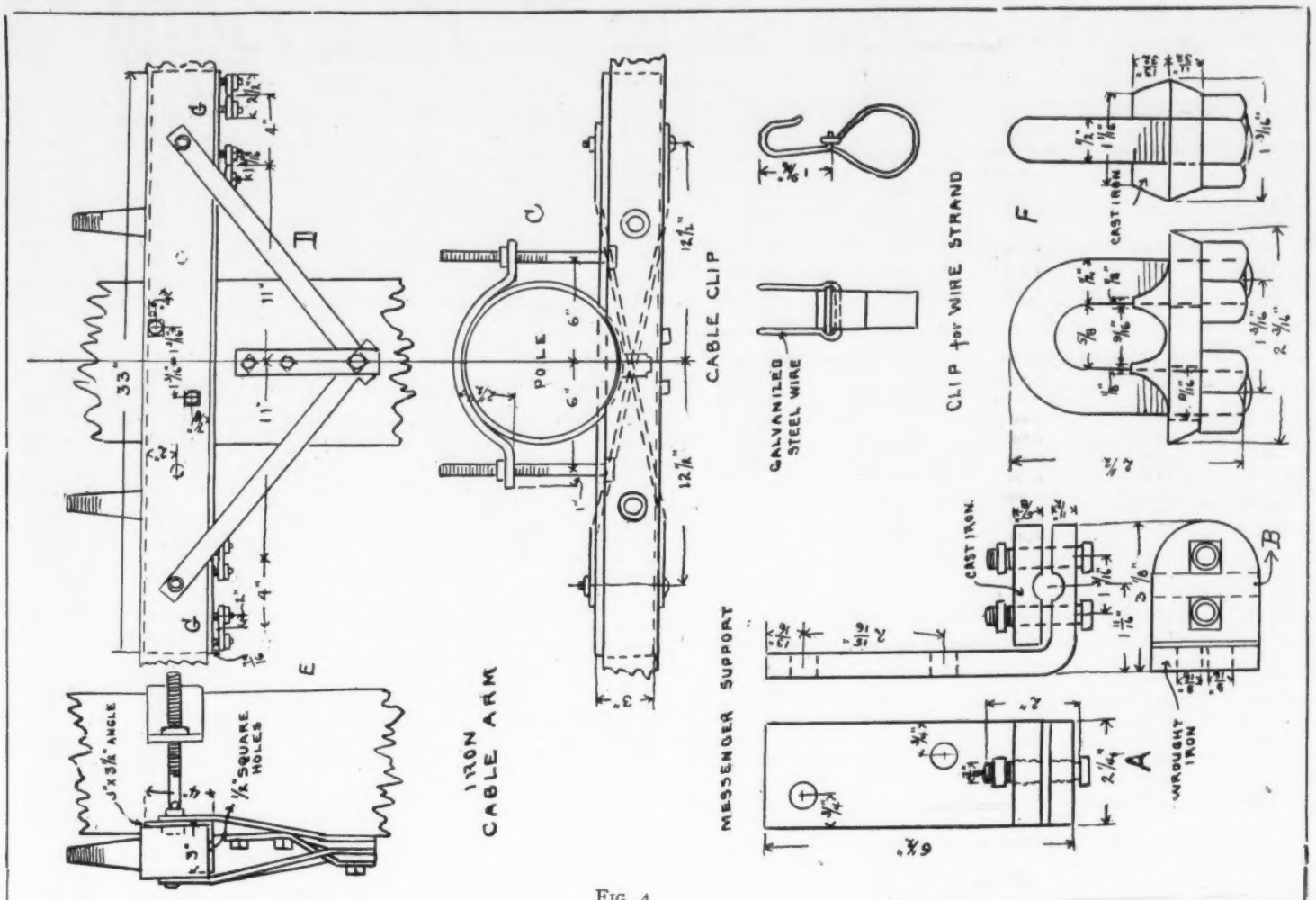

IRON CABLE ARM
POLE
CABLE CLIP
GALVANIZED STEEL WIRE
CLIP for WIRE STRAND
CAST IRON
MESSENGER SUPPORT
WROUGHT IRON
2½"x3½" ANGLE
½" SQUARE HOLES

FIG. 4.

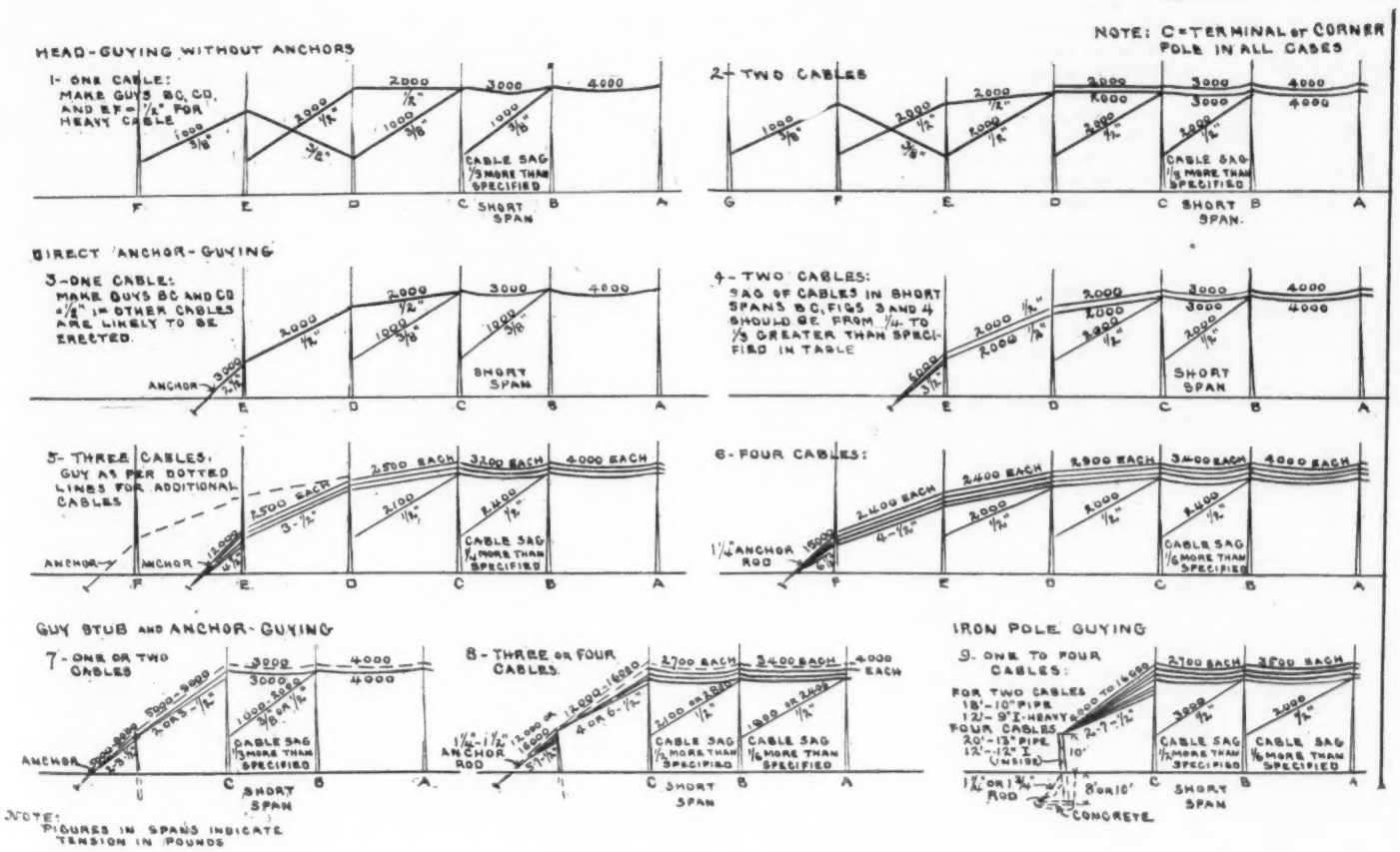

NOTE: C = TERMINAL or CORNER POLE IN ALL CASES
HEAD-GUYING WITHOUT ANCHORS
1- ONE CABLE: MAKE GUYS BC, CD, AND EF = ½" FOR HEAVY CABLE
2- TWO CABLES
CABLE SAG ⅓ MORE THAN SPECIFIED
SHORT SPAN
DIRECT ANCHOR-GUYING
3- ONE CABLE: MAKE GUYS BC AND CD ½" IN OTHER CABLES ARE LIKELY TO BE ERECTED.
4- TWO CABLES: SAG OF CABLES IN SHORT SPANS BC, FIGS 3 AND 4 SHOULD BE FROM ¼" TO ⅓ GREATER THAN SPECIFIED IN TABLE
5- THREE CABLES: GUY AS PER DOTTED LINES FOR ADDITIONAL CABLES
6- FOUR CABLES:
ANCHOR
1¼" ANCHOR ROD
GUY STUB AND ANCHOR-GUYING
7- ONE OR TWO CABLES
8- THREE OR FOUR CABLES.
IRON POLE GUYING
9- ONE TO FOUR CABLES:
FOR TWO CABLES 18'-10" PIPE 12'-9" I-HEAVY
FOUR CABLES 20'-13" PIPE 12'-12" I UNSIDED
CONCRETE
NOTE: FIGURES IN SPANS INDICATE TENSION IN POUNDS

FIG. 5.

TABLE 9.

SAG OF CABLES AND TOTAL TENSION IN SUSPENSION STRANDS AT DIFFERENT TEMPERATURES.

50-PAIR CABLE.

Temp. F.°	80-foot Span: Sag in inches at center.	80-foot Span: Tension in pounds.	100-foot Span: Sag in inches at center.	100-foot Span: Tension in pounds.	120-foot Span: Sag in inches at center.	120-foot Span: Tension in pounds.	150-foot Span: Sag in inches at center.	150-foot Span: Tension in pounds.	200-foot Span: Sag in inches at center.	200-foot Span: Tension in pounds.
20	6	4,000	9⅓	4,000	13½	4,000	21	4,000	37	4,000
0	6½	3,650	10	3,700	14½	3,700	22	3,750	39	3,800
20	7	3,300	11	3,400	15½	3,450	23½	3,500	41	3,600
40	8	3,000	12	3,100	16½	3,200	25	3,300	43	3,450
60	8½	2,700	13	2,850	18	2,950	27	3,100	45	3,300
80	9½	2,450	14	2,600	19½	2,750	28½	2,900	47	3,150
100	10½	2,200	15½	2,400	21	2,550	30	2,750	49	3,000

100-PAIR CABLE.

Temp. F.°	80-foot Span: Sag in inches at center.	80-foot Span: Tension in pounds.	100-foot Span: Sag in inches at center.	100-foot Span: Tension in pounds.	120-foot Span: Sag in inches at center.	120-foot Span: Tension in pounds.	150-foot Span: Sag in inches at center.	150-foot Span: Tension in pounds.	200-foot Span: Sag in inches at center.	200-foot Span: Tension in pounds.
20	8	4,000	13	4,000	18½	4,000	28½	4,000	51	4,000
0	9	3,700	13½	3,750	19½	3,800	30	3,800	53	3,900
20	9½	3,400	14½	3,500	20½	3,550	31½	3,650	54½	3,750
40	10½	3,150	15½	3,250	22	3,350	33	3,500	56½	3,600
60	11	2,900	16½	3,050	23	3,200	34½	3,300	58½	3,500
80	12	2,700	18	2,850	24½	3,000	36	3,200	60	3,400
100	13	2,500	19	2,700	26	2,850	37½	3,050	62	3,300

150-PAIR CABLE.

Temp. F.°	80-foot Span: Sag in inches at center.	80-foot Span: Tension in pounds.	100-foot Span: Sag in inches at center.	100-foot Span: Tension in pounds.	120-foot Span: Sag in inches at center.	120-foot Span: Tension in pounds.	150-foot Span: Sag in inches at center.	150-foot Span: Tension in pounds.	200-foot Span: Sag in inches at center.	200-foot Span: Tension in pounds.
20	9.0	4,000	14.5	4,000	20.5	4,000	31.5	4,000	56.0	4,000
0	10.0	3,700	15.0	3,750	21.5	3,800	33.0	3,800	58.0	3,900
20	10.5	3,400	16.0	3,500	22.5	3,550	34.5	3,650	60.0	3,750
40	11.5	3,150	17.0	3,250	24.0	3,350	36.0	3,500	62.0	3,600
60	12.0	2,900	17.5	3,050	25.5	3,200	38.0	3,300	64.0	3,500
80	13.0	2,700	19.5	2,850	27.0	3,000	39.0	3,200	66.0	3,400
100	14.5	2,500	21.0	2,700	28.5	2,850	41.0	3,050	68.0	3,300

the messenger wire shall, if necessary, be readjusted until it corresponds to the specifications of Table 9.

SECTION 72.

72 Method of Terminating

Three methods shall be used for terminating aerial cable.

1st. Connection to underground cable. Where aerial cable is to connect with an underground cable, the underground conduit, by means of an iron pipe 3 inches in diameter, shall be extended alongside of the terminal pole for a distance of at least 10 feet above the sidewalk. Either the aerial cable or the underground cable, as the Company may elect, shall be extended through this pipe. In case the Company shall elect to extend the underground cable, the splice between the aerial and the underground cable shall be made directly above the iron pipe extending along the pole. This splice shall be made as specified in B 1. In case the Company shall elect to extend the aerial cable into the manhole, the cable shall be run downwards through the iron pipe into the manhole and the splice and between the underground and aerial made in the manhole, as specified in B 1.

SECTION 73.

73 Connections to Open Wire Lines

At each point where the aerial cable shall terminate and enter an open wire line, a proper box and balcony shall be supplied and bolted to the pole, as shown in Fig. 6. The box and balcony shall be of such design as is approved by the Company, and shall be supplied by..... and shall be erected in place substantially, shown in Fig. 6 by..... The cable terminal shall be either a cable head, as specified in C 1, or a flexible terminal, as specified in C 2, as the Company may elect. After the cable is terminated it shall be secured to the pole and brought into the pole box as shown in Fig. 6. In all cases

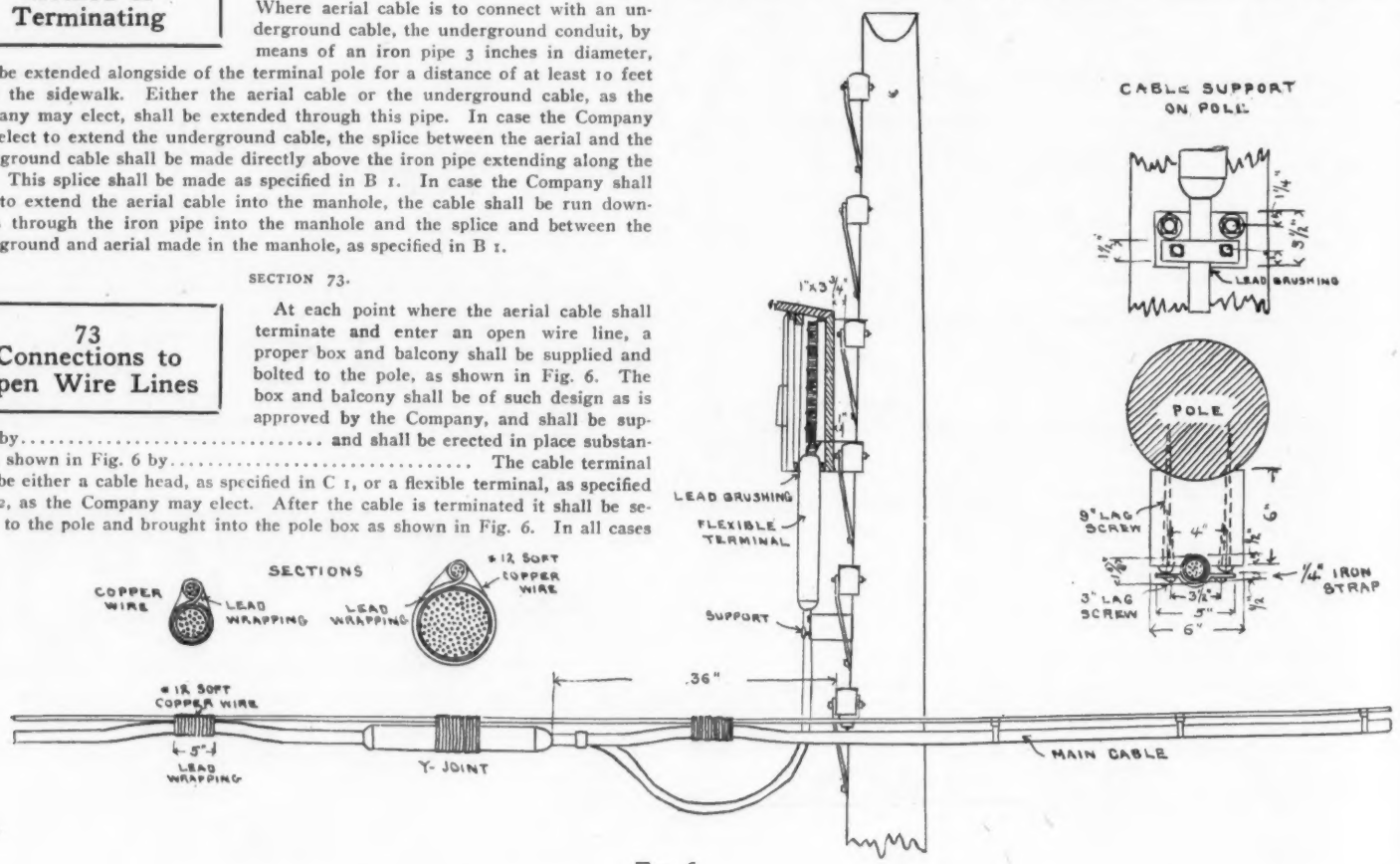


FIG. 6.

pains shall be taken to carry the cable to the pole with a long, round, easy bend, and in such a manner as not to kink, injure or hurt the cable in any way. A lead bushing shall be inserted in the base of the box through which the cable shall enter. All flexible terminals to aerial lines shall be made of Okonite wire, as specified in C 2. The Okonite shall be carefully formed, neatly lashed, and carefully secured to the back of the box, each wire being carried to its proper terminal and there soldered. If the cable head is to be used the cable shall be terminated in the head as specified in C 1. After the cable is spliced into the head the head shall be placed in the box and bolted to the back thereof. After the cable is erected in place and terminated it shall be inspected, as provided for in A 1. The Inspector shall test each wire from the terminal point at which the bridle wire is to be attached, to the other terminal of the cable wherever this may be situated, and each wire must fulfill each and all of the requirements specified under A 1.